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Upward Bound Math-Science: Program Description and Interim Impact Estimates

Upward Bound Math-Science: Program Description and Interim Impact Estimates

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EXECUTIVE SUMMARY

For many years, policymakers have been concerned by the relatively low levels of academic achievement by economically disadvantaged K-12 students in math and science, by the underrepresentation of disadvantaged college students in math and science majors, and by the underrepresentation of people from disadvantaged groups in math and science careers. While racial gaps in math and science test scores narrowed somewhat in the 1970s and 1980s, substantial gaps persisted through the 1990s to the present.

To help address these disparities, the U.S. Department of Education (ED) established a math and science initiative in 1990 within Upward Bound, a federal grant program designed to provide disadvantaged high school students with skills and experiences that will prepare them for college success. The initiative, referred to as Upward Bound Math-Science (UBMS), awards grants to institutions—largely colleges and universities—to operate UBMS projects. These projects were designed to differ from "regular" Upward Bound projects in several respects. To ensure that participants receive an intensive math and science precollege experience, UBMS projects provide instruction that includes hands-on experience in laboratories, computer facilities, and at field sites. Opportunities are also provided to learn from mathematicians and scientists employed at the host institution or engaged in research or applied science in other institutions in the community. A six-week summer program providing intensive instruction in laboratory science and mathematics through precalculus is also offered.

Initially, ED funded 30 UBMS projects. by FY 2004, there were 127 UBMS projects serving 6,845 students at a total cost of $32.8 million. Therefore, the annual cost per student—approximately $4,800—is comparable in cost to regular Upward Bound but much more expensive than other federally funded precollege programs. More than 80 percent of UBMS projects are hosted by four-year colleges and universities; most of the rest are hosted by two-year colleges (Curtin and Cahalan 2004).

Participants in UBMS must meet the same eligibility requirements as regular Upward Bound students: students must (1) belong to families classified as low-income (taxable income of no greater than 150 percent of the poverty line), or (2) be a potential first-generation college student (neither parent has a bachelor's degree). Some students who participate in UBMS summer programs are referred from regular Upward Bound programs and then return to those programs during the academic year. However, as would be expected, UBMS projects are more likely to consider students' interests in math and science when reviewing applications than are most regular Upward Bound projects (Moore 1997b). While 25 percent of participants are white, most program participants are from underrepresented minority groups: about 60 percent of participants are African American or Hispanic (Curtin and Cahalan 2004).

EVALUATION OF UPWARD BOUND MATH-SCIENCE

Since 1991, Mathematica Policy Research, Inc., (MPR) has been conducting the National Evaluation of Upward Bound for ED. The centerpiece of this evaluation has been a random assignment evaluation of regular Upward Bound. In 1997, ED added a new component to the evaluation that is focused on UBMS. In 1998, MPR selected a random sample of the students

who participated in UBMS between 1993 and 1995 at projects that were still operating at that time. This report constitutes the first of two evaluation reports on UBMS, and it is based on participant surveys and student transcripts collected for this sample between 1998 and 1999 and again between 2001 and 2002. The second report is scheduled for completion in 2006 and will be based on data collected between 2003 and 2005.

The evaluation of UBMS has two components: a descriptive analysis and an impact analysis. The descriptive analysis relies primarily on a survey of project directors to describe the resources available to UBMS projects; the types of institutions that host them; the credentials and demographic characteristics of project staff; recruitment, eligibility, and enrollment of students; student characteristics; and program offerings. The impact analysis is designed to measure the effects of UBMS on (1) performance in high school, especially in math and science courses; (2) postsecondary attendance, persistence and completion; and (3) the likelihood of completing a postsecondary degree in mathematics or a scientific field.

The impact analysis is based on a comparison of UBMS participants with a sample of students that (1) applied to enroll in regular Upward Bound programs in the early 1990s, (2) never participated in UBMS and (3) have been tracked by MPR as part of the national evaluation. This comparison group was selected to ensure that it had similar characteristics to the sample of UBMS participants, and we controlled statistically for the small remaining differences in these characteristics between UBMS participants and the comparison group.

If UBMS participants are more interested or skilled in math and science than the students in the comparison group, the estimated effects of the program may be subject to "selection bias" and may overstate the true effects of participating in UBMS. However, the comparison group we selected was probably the best available short of a randomized control group because the students in the comparison group exhibited the motivation to pursue Upward Bound services, and our analysis shows that the participant and comparison groups are similar in other ways as well. In addition, we implemented a data collection and analysis plan designed to minimize selection bias (see Chapter III for more details). While a control group from a randomized experiment would have prevented selection bias, the comparison group we selected greatly reduced the cost of the evaluation because we were already collecting data for this group as part of the national evaluation.

Note that the descriptive findings and impact estimates presented in this report describe the operations and effects of the Upward Bound Math-Science Program as it operated in the mid-1990s. At that time, it was a relatively new program, and some changes have occurred in how UBMS projects operate. In Chapter II, we mention some of these changes as they are reflected in information provided to us by UBMS project directors in a survey of grantees. It is certainly possible that some of the changes in the program since the mid-1990s have influenced the effectiveness of UBMS projects, and the evaluation does not attempt to measure any changes in effectiveness since that time. In this report, we measure the effects of the program on people who participated between 1993 and 1995 and describe the operations of the program at that time.

REPORT FINDINGS

From our descriptive analysis, we found that UBMS projects:

- ***Provide a large quantity of academic instruction.*** in the summer, the average UBMS project provided a total of 240 hours of academic instruction, and participation in the program is roughly full-time for a six-week period.
- ***Are most active during the summers.*** UBMS projects typically provide services, such as tutoring or study sessions, during the school year, but they provide most of their services during summer residential programs at the colleges or universities hosting the program.
- ***Provide academic enrichment in math and science subjects.*** Many UBMS projects offer courses in algebra II, geometry, precalculus, biology, chemistry, physics and computer software; in contrast, few offer courses in Social Studies (though many offer English courses in addition to their math and science offerings). At most projects, the course work is designed to provide academic enrichment instead of academic remediation.
- ***Provide instruction through a combination of single-subject courses and interdisciplinary instruction.*** While other instructional techniques were used, three out of four projects provided instruction primarily through single-subject academic courses or the combination of these courses with interdisciplinary instruction.

Given the academic services provided by UBMS, it is natural to ask whether participating in UBMS affects the educational outcomes of the students that participate. From our impact analysis, we found that UBMS:

- ***Improved high school grades in math and science and overall.*** UBMS had a positive effect on high school grades, increasing the average GPA in math courses from 2.7 to 2.8, the average GPA in science courses from 2.7 to 2.9 and the average GPA overall.
- ***Increased the likelihood of taking chemistry and physics in high school.*** UBMS increased the likelihood that participants took upper-level science courses in high school, raising the percentage of students taking chemistry from 78 percent to 88 percent and raising the percentage of students taking physics from 43 percent to 58 percent. in contrast, UBMS did not affect coursetaking in advanced math subjects (see Chapter III, Exhibit III.3).
- ***Increased the likelihood of enrolling in more selective four-year institutions.*** UBMS increased the percentage of students that attended four-year colleges and universities from 71 percent to 82 percent. The increase in four-year attendance is particularly pronounced for more selective schools (those rated as "most selective", "highly selective" or "very selective" by the Barron's Guide): UBMS increased the percentage of students that attended more selective four-year colleges from 23 percent to 33 percent (see Chapter III, Exhibit III.4).

- ***Increased the likelihood of majoring in math and science.*** UBMS affected students' choice of major, increasing the percentage majoring (or planning to major) in math or science from 23 percent to 33 percent and decreasing the percentage majoring in a field outside of math or science and the social sciences from 51 to 42 percent. UBMS also seems to increase the percentage of participants majoring in the social sciences (see Chapter III, Exhibit III.6).

- ***Increased the likelihood of completing a four-year degree in math and science.*** UBMS increased the percentage of students that earned a bachelor's degree in a math and science field from 6 percent to 12 percent and decreased the percentage that earned a bachelor's degree outside of math, science, and the social sciences from 20 to 14 percent (see Chapter III, Exhibit III.6). Because 47 percent of participants in our sample were still in college when we interviewed them in 2002, findings related to degree completion should be treated as preliminary, and a final assessment will be presented in a subsequent report.

In addition, we computed separate impact estimates for subgroups defined by sex, race and ethnicity, and prior participation in regular Upward Bound. For some outcomes, we found differences in subgroup impacts that were statistically significant. For example, the effect of UBMS on four-year college attendance was larger for women than for men. However, the number of significant differences between subgroups was relatively small, and there was no obvious pattern to the findings suggesting that particular groups benefited more from UBMS than other groups. Therefore, it is not clear whether the significant subgroup differences are due to chance or to systematic differences in the effects of UBMS on different groups of participants.

To summarize the report's findings, UBMS provides intensive academic instruction in math and science, and our impact estimates suggest that it improves several student outcomes in high school and college. In addition, and consistent with the objectives of the program, preliminary estimates suggest that UBMS participation increases the odds of majoring in math or science. In the next report, we will reexamine the effects on college completion, examine the effects on labor market outcomes, such as employment in the sciences, and weigh the benefits of the program against the costs.

It is tempting to compare the estimated impacts of UBMS to the estimated impacts of regular Upward Bound presented in earlier reports. However, it is important to recognize that the two studies used different methods: while the evaluation of regular Upward Bound is based on an experimental design, the "gold standard" in evaluation research, the evaluation of UBMS is based on nonexperimental methods that may suffer from selection bias, as described earlier. If the estimated effects of UBMS are inflated due to selection bias, then the impression based on our findings that UBMS is more effective than regular Upward Bound might be attributable to differences in the methods used to estimate the impacts instead of differences in the effectiveness of the two programs.

I. INTRODUCTION

For many years, policymakers have been concerned by the relatively low levels of academic achievement by economically disadvantaged K-12 students in math and science, by the underrepresentation of disadvantaged college students in math and science majors, and by the underrepresentation of people from disadvantaged groups in math and science careers. National statistics show that while the gaps between minorities'[1] and whites' math and science test scores narrowed somewhat in the 1970s and 1980s, gaps in test scores and other educational outcomes persisted through the 1990s to the present.

- ***Disadvantaged students take fewer math and science courses in high school.*** in the 1991–92 school year, 57 percent of seniors in the lowest socioeconomic status (SES) quartile took a math course, compared with 75 percent of seniors from the highest SES quartile; 37 percent of seniors from the lowest SES quartile took a science course, compared with 61 percent of seniors from the highest SES quartile (U.S. Department of Education 1996b). in 1994, only 58 percent of black high school graduates had completed geometry while in high school, compared with 73 percent of white high school graduates. in the same year, only 13 percent of black and Hispanic graduates had completed the common triad of science courses—biology, chemistry, and physics—compared with 23 percent of white graduates (U.S. Department of Education 1996a).

- ***Minority college students are less likely to take math and science courses or earn a degree in math or science.*** ***T***en percent of black college students and 14 percent of Hispanics received credit for calculus or advanced math courses in the late 1980s, compared with 22 percent of whites. Sixteen percent of blacks and 21 percent of Hispanic college students earned course credits in chemistry, compared with 27 percent of whites, and 8 percent of blacks and 11 percent of Hispanics earned college credit for physics, compared with 18 percent of white students (U.S. Department of Education 1994). Because minorities earned fewer college credits in math and science than whites, it is not surprising that they were less likely to earn degrees in those subjects. Black students earned 7 percent of all bachelor's degrees in 1995-96, but just 7 percent of all bachelor's degrees in math and science fields. in the same year, Hispanic students earned 5 percent of all bachelor's degrees, but just 4 percent of all bachelor's degrees in math and science (U.S. Department of Education 1999).[2]

[1] Ideally, socioeconomic measures such as income would be used to define groups, rather than race or ethnicity. For most education outcomes of interest, however, data are not presented on different income groups. Because racial and ethnic minorities are disproportionately lower-income (U.S. Census Bureau 2001:40), data based on race and ethnicity offer a reasonable, albeit imperfect, estimate of economically disadvantaged students' educational experiences.

[2] The following subjects were classified as math or science: biological sciences and life sciences, computer and information sciences, engineering, engineering-related technologies, mathematics, and physical sciences and science technologies.

- ***Minorities are less likely than whites to enter careers in math and science.*** Among people who were working in a scientific field in 1995 and had obtained their college degree in the previous five years, only 6 percent were black (National Science Foundation 1995). However, in 1990, around the time those individuals would have been in college, blacks accounted for 14 percent of the U.S. population aged 18-24 years old (Census Bureau 1990a, Census Bureau 1990b).

A. UPWARD BOUND MATH-SCIENCE PROGRAM

To help address these disparities, the U.S. Department of Education (ED) in 1990 established the Upward Bound Math-Science Program (UBMS) within Upward Bound, a federal grant program designed to provide disadvantaged high school students with skills and experiences that will prepare them for college success. UBMS was designed to differ from "regular" Upward Bound in a few key respects. To ensure that participants receive an intensive math and science precollege experience, ED requires UBMS projects to provide instruction that includes hands-on experience in laboratories, computer facilities, and at field sites. Also provided are the following: opportunities to learn from mathematicians and scientists employed at the host institution or engaged in research or applied science in other institutions in the community;[3] involvement with tutors and counselors who are graduate and undergraduate math and science majors; and a six-week summer program consisting of daily course work and activities, instruction in laboratory science and mathematics through precalculus (in addition to foreign language, composition and literature, which are also required offerings at regular Upward Bound projects).

Initially, ED funded 30 UBMS projects. By FY 2004, there were 127 UBMS projects serving 6,845 students at a total cost of $32.8 million. Therefore, the annual cost per student—approximately $4,800—is comparable in cost to regular Upward Bound but much more expensive than other federally funded precollege programs. More than 80 percent of UBMS projects are hosted by four-year colleges and universities; most of the rest are hosted by two-year colleges (Curtin and Cahalan 2004).

UBMS participants must meet the same eligibility requirements as regular Upward Bound participants: they must (1) come from families that are classified as low-income (taxable income not over 150 percent of the poverty line), or (2) be a potential first-generation college student (neither parent has a bachelor's degree). Some students who participate in UBMS are referred from regular Upward Bound programs and then return to those programs during the academic year. However, as would be expected, UBMS projects are more likely to consider students' interests in math and science when reviewing applications than are most regular Upward Bound projects (Moore 1997b). While 25 percent of participants are white, most program participants are from underrepresented minority groups: about 60 percent of participants are African American or Hispanic (Curtin and Cahalan 2004).

[3] This requirement may have stemmed from concern that too much math and science instruction in high school is provided by teachers teaching out of their own field.

Despite coming from low-income families, the evidence suggests that on average, UBMS serves students who do well in high school and attend college at higher rates than the average low-income student. Data reported by Upward Bound projects suggest that prior to participating in Upward Bound, UBMS participants earned higher grades on average than regular Upward Bound participants (Curtin and Cahalan 2004). In addition, the national evaluation has shown that regular Upward Bound participants would have attended college at much higher rates than the average low-income student even if they had not participated in Upward Bound (Myers et al. 2004).[4] Therefore, the evidence strongly suggests that UBMS serves high school students who are much more likely to attend college than the average low-income student.

B. EVALUATION OF THE UPWARD BOUND MATH-SCIENCE PROGRAM

The legislation establishing Upward Bound authorizes ED to sponsor studies of it, including examinations of program effectiveness. In 1991, ED awarded a contract to Mathematica to conduct the National Evaluation of Upward Bound. This evaluation has several components, but its signature feature is an experiment to measure the effects of participating in regular Upward Bound. We selected a random sample of Upward Bound projects (excluding UBMS projects); for each of these projects, we randomly assigned eligible applicants to a treatment group, which was offered the chance to participate in the program, or a control group, which was not. The evaluation is ongoing, and it was one of the first to use experimental methods to measure the effects of a federally funded education program.

This report presents the results of an evaluation of the Upward Bound Math-Science Program. In 1997, Mathematica completed two reports on UBMS. One provided a descriptive analysis of the program based primarily on site visits to a representative sample of 14 UBMS projects (Moore 1997a). The other provided an assessment of the feasibility of conducting a rigorous evaluation of the effects of UBMS on student outcomes (Myers 1997). When ED awarded a contract to Mathematica in 1997 to extend its evaluation of the effects of regular Upward Bound, it also specified an evaluation of the effects of UBMS. This evaluation consists of two components: a descriptive analysis and an impact analysis. The descriptive analysis relies primarily on a survey of UBMS project directors conducted in the spring of 1998. The analysis is designed to describe the resources available to UBMS projects; the types of institutions that host them; the credentials and demographic characteristics of project staff; recruitment, eligibility, and enrollment of students; student characteristics; and a description of the program, including its goals, academic orientation, instructional methods and the intensity and quantity of the services provided.

The UBMS impact study is designed to measure the effects of participating in UBMS on college enrollment, choice of major, and other outcomes for students who participated during the

[4] While the last report from the national evaluation shows that about 70 percent of regular Upward Bound participants would have attended a postsecondary institution even if they had not participated in Upward Bound (Myers et al. 2004), only 53 percent of 1992 high school graduates from the lowest SES quartile attended a postsecondary institution by 1994 (U.S. Department of Education 1997).

summer of 1993, 1994, or 1995.[5] Conceptually, the study contrasts how participants fared with how they would have fared if they had not participated in UBMS. We compared UBMS participants with eligible applicants to the regular Upward Bound projects participating in the national evaluation. From this pool, we systematically selected a matched comparison group of students who were as similar as possible to UBMS participants in terms of characteristics and experiences that could potentially predict later outcomes. These characteristics included demographics—such as sex, race, and ethnicity—and prior academic achievement such as grade point average and math and science courses taken in 9th grade. The key difference was that the matched comparison students did not participate in UBMS.

The selection of matched comparison students also took into account experiences in other precollege programs, in particular regular Upward Bound. Because regular Upward Bound is an intensive program that can influence high school achievement and postsecondary outcomes (Myers and Schirm 1999; Myers et al. 2003), it is important to account for exposure to regular Upward Bound when estimating how UBMS participants would have fared if they had not participated in UBMS. For UBMS participants who had previously participated in a regular Upward Bound program—perhaps during the academic year—we selected comparison students who had also participated in the regular Upward Bound.[6] For UBMS participants who had not participated in regular Upward Bound, we selected comparison students who did not participate in regular Upward Bound.[7]

Several data sources play a key role in the impact analysis. Baseline characteristics were collected for comparison group members through the baseline survey for the evaluation of regular Upward Bound; baseline information on many of the same characteristics was collected for UBMS participants through a follow-up survey conducted in 1999.[8] This follow-up survey was used to collect information about educational outcomes for UBMS participants, and a similar survey was used to collect analogous information for comparison students. Finally, secondary and postsecondary transcripts were collected for both types of students to assess academic achievement.

C. OVERVIEW OF THIS REPORT

The remainder of this report is organized as follows. Chapter II describes the operation of the UBMS program. Chapter III presents findings from the impact analysis.

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[5] Because the sample was not selected until 1998, we restricted the sample to participants at UBMS projects that were still operating that year: obtaining lists of participants from programs that were no longer operating in 1998 would have been nearly impossible.

[6] These comparison students were selected from the treatment group for the evaluation of regular Upward Bound. For a more thorough discussion of how the treatment group was selected, see Myers et al. (2004), Appendix A.

[7] These comparison students were selected from the control group for the evaluation of regular Upward Bound. For a more thorough discussion of how the control group was selected, see Myers et al. (2004), Appendix A.

[8] While the 1999 survey was conducted four to six years after our sample had participated in the program, most of the baseline information collected—including sex, race, and ethnicity—is time-invariant.

II. THE OPERATION OF THE UPWARD BOUND MATH-SCIENCE PROGRAM

To interpret information on the impacts of UBMS, it is necessary to understand what the program entails. This chapter describes key features of the operations of UBMS projects, including the characteristics of host institutions and staff, projects' recruitment practices and enrollment levels, participants' characteristics and projects' goals and services. For context, this chapter presents comparable information on the operations of regular Upward Bound when possible.

The primary data source for this chapter is a survey of UBMS projects conducted in the spring of 1998. The survey sample consisted of all 81 projects operating at the time, and 74 of the 81 projects responded to the survey.[9,10] the survey requested information about program operations in two separate years—(1) 1994 (in the middle of the period over which our sample was participating in UBMS) and (2) 1998 (the year prior to the survey)—but some questions were specific to 1998. When possible, we focus our analysis of program operations on 1994 to facilitate comparisons with regular Upward Bound projects operating in 1993, as reported in Fasciano and Jacobson (1997) and to describe the programs that served the same cohorts of participants for whom we measured the impacts of the program (see Chapter III).[11] To augment the information provided by the survey of UBMS projects, we also use information from case studies and annual performance reports (Moore 1997b).

The findings in this chapter indicate that UBMS projects provide intensive academic enrichment to disadvantaged high school students in math and science using staff with strong academic credentials in those subjects. Some of the features that make UBMS projects distinctive, even from regular Upward Bound projects, are: (1) high levels of annual funding per student and low student-teacher ratios, (2) recruiting strategies that attract students from wide geographic areas, (3) service provision that is heavily concentrated in residential programs during the summer, (4) course offerings that focus on math and science relative to other subjects, (5) academic preparation over nonacademic college preparatory activities, and (6) academic enrichment over remediation. The remainder of the chapter provides a description of UBMS and an assessment of its distinctive features.

[9] We did not adjust (weight) for survey nonresponse, reasoning that the number of nonrespondents was low enough to eliminate any serious concerns about data representativeness. Also, rarely did more than three UBMS projects fail to respond to any particular item on the questionnaire.

[10] We excluded the one project that reported serving only veterans in 1998. Note that veterans' projects were also excluded from the survey of regular Upward Bound grantees, so the comparisons that are made in this chapter between the two types of Upward Bound programs are based on Upward Bound projects that did not exclusively serve veterans.

[11] Unless noted otherwise, the results for 1998 were generally similar to those for 1994.

A. PROJECT HOSTS AND STAFF

The impacts of UBMS projects on student outcomes may depend on the types of institutions that host them and the people they hire to serve as instructors and other staff. In this section, we describe the types of institutions that host UBMS projects and the staff that provide services to program participants.

1. Host institutions: Two- and Four-Year Colleges and Universities

The types of institutions that host a UBMS project may influence where students attend college. Most Upward Bound programs are hosted by either two- or four-year postsecondary institutions. Evidence from the national evaluation of regular Upward Bound suggests that participation at projects hosted by four-year colleges raises the probability of attending a four-year college, and participation at projects hosted by two-year colleges raises the probability of attending a two-year college (Myers et al. 2002b). Therefore, the types of institutions that host UBMS projects may influence the types of postsecondary institutions that program participants subsequently attend.

Nearly nine out of ten UBMS projects operating in the mid–1990s were hosted by four-year colleges, a substantially higher proportion than among regular Upward Bound projects (see Exhibit II.1). Four-year colleges may find it easier than other potential host institutions to meet some of ED's guidelines for UBMS, including offering hands-on experience in laboratories and computer facilities, opportunities to learn from mathematicians and scientists engaged in research or applied science and involvement with tutors and counselors who are graduate and undergraduate students in math and science.

2. Summer Program Staff and Project Director

UBMS projects are directed by highly educated individuals and staffed by people with strong credentials in math and science. These staff have responsibility for a relatively small number of students, which may provide opportunities for individual instruction. At the typical project, the project director and staff can provide same-race role models for many of the students they serve. The sections below provide more detail on our findings concerning staff size and composition by job title, staff credentials, and the racial composition of project staff.

a. Staff Size and Composition by Job Title

In 1994, UBMS projects had an average of 24 staff members, comprising roughly eight instructors, five resident counselors, four mentors, three tutors, two administrators, one academic or guidance counselor and one clerical staff member.[12] Overall, the average student-staff ratio in summer 1998 was 2:1, with a range from about 1:1 to 5:1.

[12] By 1998 the average MSC had almost 26 staff, including 9 instructors.

Exhibit II.1

Types of Institutions that Hosted UBMS Projects, 1995

Type of institution	Upward Bound Math-Science	Regular Upward Bound
Four-year college or university	88%	68%
Two-year college	11	28
Other institution	2	4

NOTE: Percentages may not sum to 100 percent due to rounding.
SOURCE: Moore 1997b, Exhibit II.1, p. 15.

These findings, combined with findings from Moore (1997b), suggest that student-staff ratios are typically lower in UBMS projects than in regular Upward Bound projects. The survey of grantees did not collect information on the number of full-time-equivalent (FTE) staff, but the information available suggests that UBMS projects typically maintain student-staff ratios that are substantially lower than in regular Upward Bound. Moore (1997b) found that 14 randomly selected UBMS projects visited in summer 1996 had an average of 2.6 students per FTE staff, including administrators, and 8.2 students per FTE instructional staff (Moore 1997b, Exhibit II.6). In contrast, tabulations from the data used by Fasciano and Jacobson (1997) indicate that in summer 1992, regular Upward Bound projects had more students per staff member—5.1 students per FTE staff and 13.6 students per FTE instructional staff (Moore 1997b, Exhibit II.6).

b. Credentials

At the average UBMS project in 1998, most staff were highly educated and had educational backgrounds in math and science. About one-quarter had attended some college but not obtained a degree, another quarter had obtained a bachelor's or associate's degree (mostly bachelor's degrees) and the rest had done graduate work or obtained a graduate degree. Most staff members without undergraduate degrees were undergraduate students who served as UBMS mentors, tutors and resident counselors while working toward bachelor's degrees in math, science, or education. Approximately two out of five staff members had their highest degree in science or the social sciences (31 percent) or math (10 percent); additionally, most staff members without a degree were working toward a bachelor's degree in math, science, or education.

Most instructors at the average UBMS project had experience teaching math or science. During the school year, most instructors were either high school teachers (41 percent) or postsecondary teachers (31 percent); one-fifth were graduate students (14 percent) or undergraduates (6 percent). Moreover, at the typical project, two-thirds of the high school teachers and three-quarters of the postsecondary teachers taught in a math or science field.

The professional and educational backgrounds of UBMS project directors provide insight on their credentials to direct projects. One-fifth of the directors were faculty members at the host institution or another college, roughly the same percentage as in regular Upward Bound. In 1998, two-thirds of the directors held a master's degree and one-fifth held a doctorate. About half had their highest degree in education, and less than one-fifth had their highest degree in

engineering, mathematics, or physical sciences.[13] Although UBMS project directors were less likely than program staff as a whole to have a background in math or science, this may not be surprising since subject area expertise is probably less important for administrators than for other staff. Compared with regular Upward Bound project directors, UBMS project directors were more highly educated. They were, for example, twice as likely to have a doctorate.

c. Race and Ethnicity

At about 9 out of 10 UBMS projects operating in 1998, one racial or ethnic group accounted for a majority of the staff (see Exhibit II.2). In many cases this pattern may have reflected a conscious strategy, also used in regular Upward Bound, to provide minority students with same-race role models. For example, at 21 UBMS projects, a majority of the staff members were black; at 18 of these, a majority of the students were also black.

The racial and ethnic profile of UBMS project directors was similar to that of UBMS project staff (see Exhibit II.3). Both staff and project directors were nearly evenly split between white and nonwhite; project directors were slightly more likely to be black and less likely to be Asian than other staff. The race and ethnicity of the UBMS project director often matched that of the predominant student racial and ethnic group: more than three-fourths of the minority directors headed programs where students from the same group constituted a plurality of participants.

B. ELIGIBILITY, RECRUITMENT AND ENROLLMENT, AND STUDENT CHARACTERISTICS

To shed light on the types of students that participate in UBMS, we examine the eligibility criteria that students must meet and the recruiting strategies that UBMS projects use to attract students. We also examine the characteristics of participants as reported by project directors.

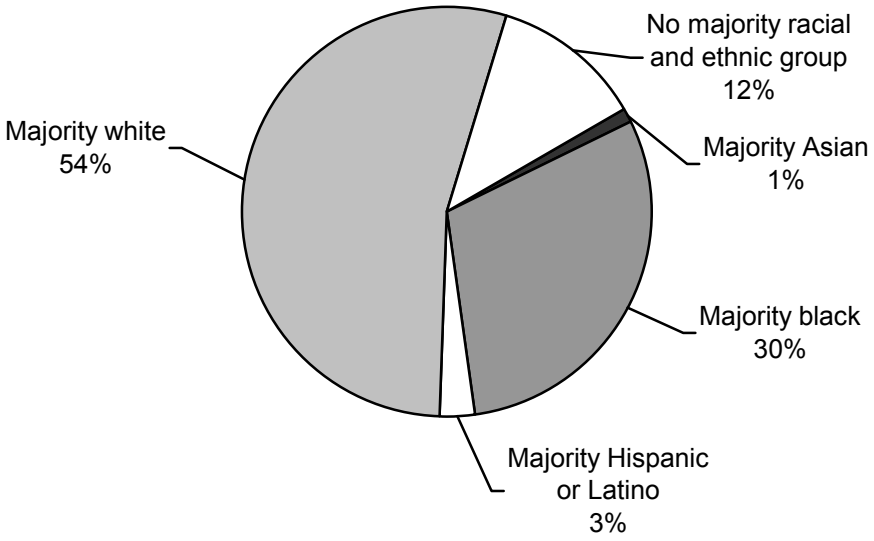
1. Eligibility

UBMS projects have to meet the same federal rules as regular Upward Bound projects concerning the composition of participants. At each project, at least two-thirds of the participants must be both low-income and potential first-generation college students; the remaining students must meet either of these two criteria. At the average project in summer 1998, about 77 percent of students met both of these eligibility criteria, about 14 percent were first-generation only and about 9 percent were low-income only, very similar to the distribution in regular Upward Bound during 1992-93. In addition, UBMS and regular Upward Bound projects are only allowed to serve students who have completed 8th grade.

[13] An additional 12 percent had their highest degree in the social sciences.

Exhibit II.2

Predominant Racial and Ethnic Group for UBMS Staff, Summer 1998



NOTE: Percentages may not sum to 100 percent due to rounding. The 12 percent of projects with no majority racial and ethnic group included 6 percent of projects with a plurality of blacks and 4 percent with a plurality of whites; the remainder had no plurality.

SOURCE: 1998 survey of UBMS projects.

Exhibit II.3

Racial and Ethnic Distribution for UBMS Staff and Project Directors, Summer 1998

Race and Ethnicity	Staff	Director
White	49%	49%
Black	33	39
Hispanic or Latino	7	7
Asian	4	1
American indian or Alaskan Native	2	4

NOTE: Percentages may not sum to 100 percent because (1) people may fall into multiple categories, (2) the Pacific Islander category was excluded from the exhibit because only nine staff members nationwide fell into this category and (3) some staff members may not have been classified by race or ethnicity.

SOURCE: 1998 survey of UBMS projects.

Most UBMS projects also adopt additional student eligibility criteria for enrollment in the program—for example, requirements about grade level, school course work, or recommendations. In 1994, over three-fourths of projects required students to have finished 9th grade; a few projects required 10th grade completion. In addition, nearly all UBMS projects required a teacher recommendation and completion of at least one high school course in math or science, and applicants enrolled in regular Upward Bound commonly needed a recommendation from the director. Finally, about 30 percent of UBMS projects prohibited students from returning from the previous summer's program, and almost half prohibited students from returning unless they met certain criteria.[14]

2. Recruitment and Enrollment

To find a pool of potentially eligible applicants, UBMS projects focused mainly on other precollege programs or secondary schools (see Exhibit II.4). Among UBMS projects operating in summer 1994, nearly all recruited from regular Upward Bound projects, while substantial majorities also recruited from Talent Search projects and from middle or high schools directly. However, it is important to note that while almost all UBMS projects recruited from regular Upward Bound projects in 1994, data from the evaluation suggest that fewer than one in five UBMS participants had previously participated in regular Upward Bound.

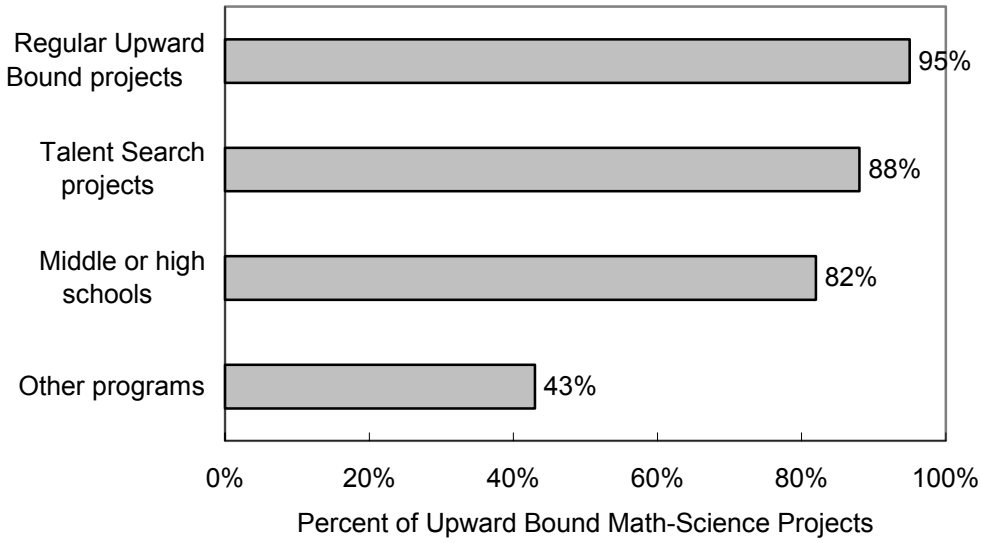
Historically, UBMS projects have cast a wide net in recruiting students beyond the local areas of the host institutions. In 1994, only about one in ten UBMS projects recruited exclusively from a specific and typically local set of feeder schools or Upward Bound projects; the rest recruited from state-wide or regional lists of schools and programs (see Exhibit II.5). By 1998, however, the percentage of UBMS projects that recruited exclusively from a specific set of feeder schools or Upward Bound projects had tripled. Therefore, it appears that over time, more UBMS projects are taking local recruitment strategies like regular Upward Bound projects.

By design, UBMS projects are smaller than regular Upward Bound projects. Through recruitment, UBMS projects received an average of 108 applications for the summer of 1994, ranging from a low of 50 to a high of 300, and they enrolled between 40 and 53 students. In contrast, regular Upward Bound programs enrolled an average of about 75 students in the mid-1990s (Moore 1997b).

[14] These practices changed dramatically by 1998, when only 7 percent of UBMS projects prohibited all students from returning from the prior summer, and 71 percent prohibited students from returning unless they met certain criteria. The questionnaire did not address the specific types of criteria that projects imposed.

Exhibit II.4

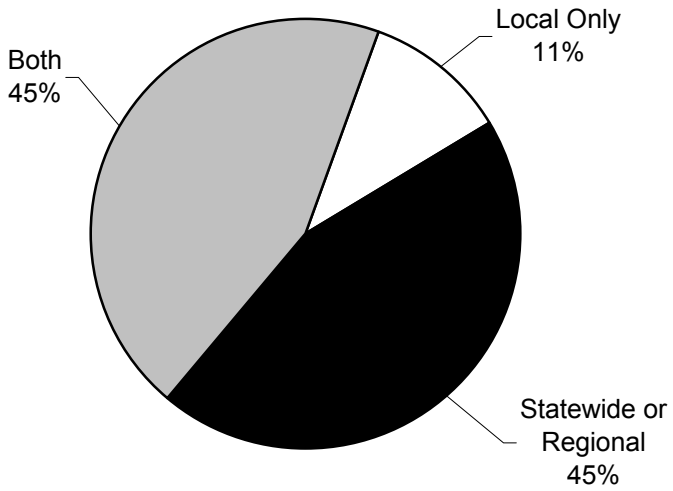
Targets for Recruiting by UBMS Projects, 1994



SOURCE: 1998 survey of UBMS projects.

Exhibit II.5

Geographic Scope of Recruiting by UBMS Projects, 1994



NOTE: Percentages may not sum to 100 percent due to rounding.
SOURCE: 1998 survey of UBMS projects.

3. Student Characteristics

In our 1998 survey of UBMS projects, project directors provided information on the distribution of students participating in their projects by sex, race, grade level, and place of residence: [15]

- ***Sex.*** At the average UBMS project, like the average regular Upward Bound project, 60 percent of students were female.16 However, this varied considerably across UBMS projects from a low of 25 percent to a high of 78 percent.

- ***Race***. On average, UBMS projects served an ethnically diverse group of students: 42 percent black, 27 percent white, 15 percent Hispanic, 8 percent Asian, 5 percent American indian and 1 percent Native Hawaiian or other Pacific Islander. However, most UBMS projects serve participants where one racial and ethnic group constituted a majority (see Exhibit II.6).[17] Furthermore, some UBMS projects exclusively served students from a single racial or ethnic group. For example, six UBMS projects reported that all of its participating students were black.

- ***Grade level. T***he eligibility guidelines discussed above, along with other factors, can affect the distribution of students across different grade levels. At the average project, 29 percent of participants were entering 12th grade, 37 percent were entering 11th grade, 27 percent were entering 10th grade and 6 percent were entering 9th grade. These exhibits suggest that on average, UBMS projects serve students who are slightly closer to graduation than is the case at regular Upward Bound projects.[18] However, there was substantial variation in the grade level distribution of participants across projects in 1998. for example, one UBMS project reported that all of its participants were entering 12th grade, while four reported that none were rising seniors.[19]

- ***Place of residence.*** Given that most projects recruited across the state or region, it is not surprising that many UBMS participants came from outside the grantee's local city or town. At the average project, only about 25 percent of the students were locals. As we would expect, projects that recruited only from a set of local schools or regular Upward Bound projects served considerably higher percentages of students from the local area than other UBMS projects.

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[15] Most of these questions were focused on 1998 participants, so the analysis in this section is focused on 1998 instead of 1994.

[16] Data based on all UBMS projects operating in 1998 and all regular Upward Bound projects operating in 1992.

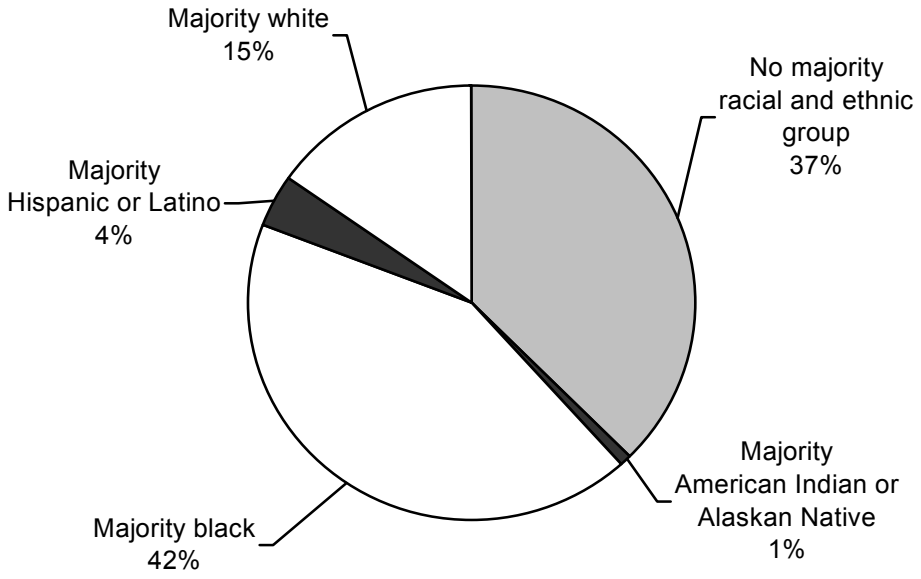
[17] In comparison, at 87 percent of regular Upward Bound projects operating in 1992–93, one racial and ethnic group accounted for a majority of participants.

[18] In regular Upward Bound during the summer of 1992, 20 percent of participants were entering 12th grade, 32 percent were entering 11th grade, 31 percent were entering 10th grade, and 16 percent were entering 9th grade.

[19] In addition, the proportion of rising juniors ranged from 0 to 72 percent, and the proportion of rising sophomores ranged from 0 to 60 percent.

Exhibit II.6

Predominant Racial and Ethnic Group for Participants at UBMS Projects, Summer 1998



NOTE: Percentages may not sum to 100 percent due to rounding. The 37 percent of UBMS projects with no majority racial and ethnic group of students included 17 percent with a plurality of white students, 11 percent with a plurality of Hispanics, 6 percent with a plurality of blacks, 3 percent with a plurality of American indians and 1 percent with a plurality of Asians.

SOURCE: 1998 survey of UBMS projects.

Moore (1997b) described UBMS participants as a more select group than regular Upward Bound participants based on having earned somewhat higher grades and having greater interest in math and science (pp. 23, 26) prior to participating in Upward Bound. Discussions with UBMS and regular Upward Bound staff revealed that UBMS participants were typically considered "more serious about school" than regular Upward Bound participants (Moore 1997b, p. 26).

C. PROGRAM DESCRIPTION

In a college-like setting, UBMS projects offer academic enrichment in math and science to improve student achievement in those subjects and expose students to math and science careers. In this section, we describe the following features of UBMS projects in more detail: the setting in which these projects provide services; the goals, academic orientation, academic offerings, and instructional approaches of these projects; and the intensity and quantity of services the UBMS projects provide.

1. Setting

As described earlier, UBMS projects are typically hosted by two- and four-year postsecondary institutions (see Section A.1). Most UBMS projects are hosted by four-year colleges and universities, and most of these institutions have dormitories to house their students. These dormitories are often available in the summers to house participants of summer programs hosted by these institutions.

UBMS projects typically exposed participants to a college setting during the summer program by housing them in the college dormitories. Virtually all the UBMS projects we surveyed (100 percent in 1994, 97 percent in 1998) offered a residential component to their summer programs, compared with 87 percent of regular Upward Bound programs in 1992 (Moore 1997a). At almost all UBMS projects, students lived in the dormitories for the entire summer program, which lasted about six weeks on average.[20] Therefore, for six weeks, participants lived on campus like many college students do during the academic year.

2. Goals of the Program

As mentioned in Chapter I, the general objective of the Upward Bound Math-Science program is to prepare participating students for postsecondary programs leading to careers in math and science. Seven out of ten UBMS projects operating in 1994 rated "academic performance in math and science" as their most or second most important goal (see Exhibit II.7). The focus on academic improvement was similar to the focus of regular Upward Bound projects operating around the same time.[21]

However, two goals that regular Upward Bound projects considered moderately important were not considered important by UBMS projects. First, only 13 percent of UBMS projects reported that one of their top two goals was fostering students' personal skills (e.g., goal orientation, ability to adapt to new settings), compared with 31 percent of regular Upward Bound programs. Second, none of the UBMS projects cited improving students' access to financial aid as one of their top two goals, compared with 35 percent of regular programs.

3. Academic Orientation

UBMS projects try to provide academic enrichment beyond what students are exposed to in school (see Exhibit II.8). Very few projects emphasized remedial instruction in 1994.[22] While

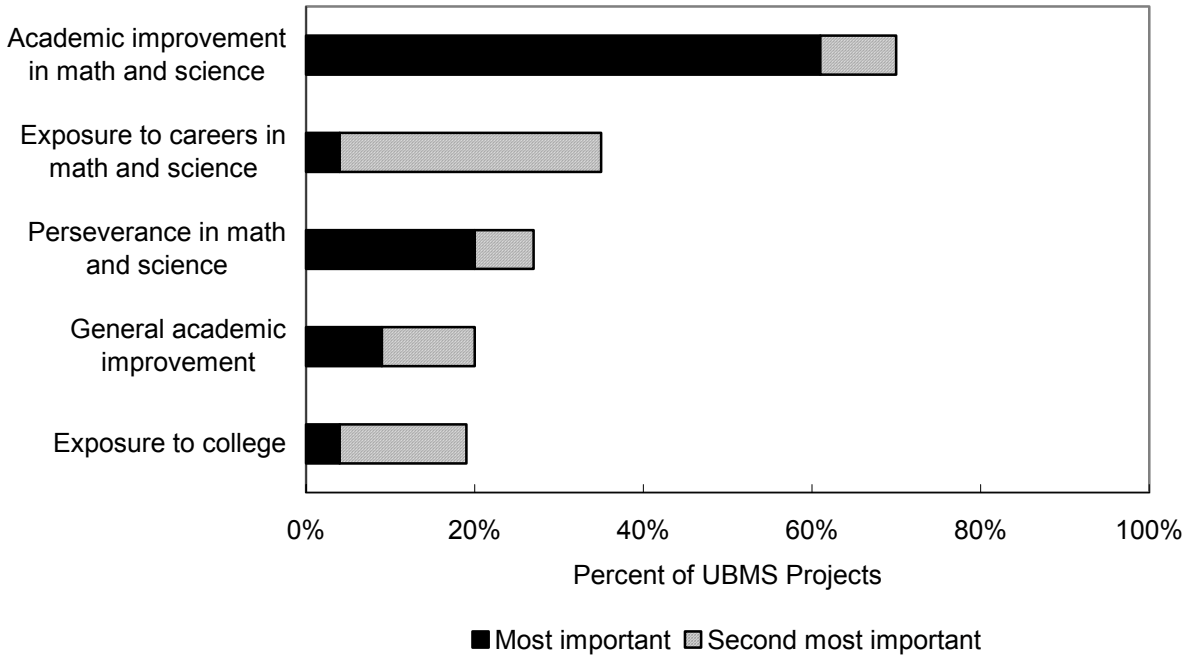
[20] Only 4 percent of UBMS projects in 1994 had a residential component shorter than the summer program, but by 1998, the rate had increased to 11 percent.

[21] Eighty-seven percent of regular Upward Bound projects rated "academic improvement" as their most or second most important goal in 1993. If the regular Upward Bound grantee survey had also listed "academic improvement in math and science," it is possible that some respondents would have cited that as one of their top two goals: Fasciano and Jacobson (1997) characterized 37 percent of regular Upward Bound projects as having a strong emphasis on math and science.

[22] By 1998, the relative focus on enrichment was even greater, with 83 percent of UBMS projects citing enrichment as a major emphasis and only 1 percent citing remediation.

Exhibit II.7

Most Important Goals of UBMS Projects, Summer 1994



SOURCE: 1998 survey of UBMS projects.

Exhibit II.8

Academic Orientation of UBMS Projects[a]

Major Emphasis	UBMS Summer 1994	Regular Upward Bound Summer 1992[b]
Support—instruction that parallels what students are taught in regular school courses	33%	55%
Remediation—instruction that concentrates on fundamental concepts and skills that were taught in earlier grades	6	23
Enrichment—instruction in concepts and material beyond what students are exposed to in regular school classes	73	69

[a] Percentages do not sum to 100 because grantees were allowed to rate more than one approach as a major emphasis.
[b] Excludes summer bridge programs for Upward Bound participants who have just graduated from high school.

SOURCES: 1998 survey of UBMS projects, Fasciano and Jacobson 1997.

about one in four regular Upward Bound programs emphasized the provision of remedial instruction, fewer than one in ten UBMS projects reported doing the same.

The focus of UBMS on academic enrichment over remediation is consistent with the types of students served by the program. As described earlier, findings in Moore (1997b) indicate that, on average, UBMS participants probably had less need for remedial support than regular Upward Bound participants.

4. Summer offerings

In accordance with program guidelines, UBMS projects offered instruction in a diverse array of academic subject areas (see Exhibit II.9). Seventy-five percent or more of these projects in 1994 offered instruction in the following subjects: writing and composition, algebra II, geometry, precalculus, computer applications and software use, biology, chemistry and physics. The average total number of offerings in 1994 was about 14, with a range of 2 to 22. The average number of offerings in math and science was about 7, with a range of 1 to 11.[23] Thus, on average, math and science courses accounted for roughly half of UBMS projects' total offerings.

UBMS projects clearly differed from regular Upward Bound projects in their relative emphasis on certain subjects. First, as expected, they concentrated their offerings more on math and science. Although UBMS projects were no more likely than regular Upward Bound projects to offer certain math or science courses (for example, algebra II, geometry precalculus, calculus, biology and chemistry), UBMS projects were much less likely to offer instruction in areas outside of math and science, such as social science or history courses or electives or non-academic courses. Second, consistent with their greater emphasis on enrichment than on remediation, UBMS projects were less likely than regular Upward Bound programs to offer low-end courses such as reading comprehension and vocabulary, pre-algebra, and earth science (see Exhibit II.9).

To help prepare students for a postsecondary education and post-collegiate careers in math or science, UBMS projects also offered a range of support services and activities (see Exhibit II.10). Among the most common activities were field trips (e.g., to math or science facilities) and assistance with college and financial aid applications. The average number of these non-instructional offerings in 1994 was about 10, with a range of 3 to 15.

UBMS projects were substantially less likely than regular Upward Bound projects to offer services focused on preparing for college. Many regular Upward Bound projects would have provided these services during the academic year: both regular Upward Bound and Math Science programs focus on academics during the summer. Because many UBMS participants participated in other precollege programs during the academic year, UBMS project staff could

[23] It is not clear why some UBMS projects apparently had such a small number of instructional offerings. One possibility is that their instructional approach centered on interdisciplinary courses or large projects that covered multiple subject areas. However, only 3 of the 12 projects that reported five or fewer math and science offerings in 1994 also reported that their primary instructional method was interdisciplinary courses or large projects and experiments. A second possibility is underreporting of instructional offerings by project directors.

Exhibit II.9

Instruction Offered by UBMS Projects, by Subject Area[a]

	UBMS Summer 1994	Regular Upward Bound 1992[b]
English/Language Arts		
Writing/Composition	93%	100%
Literature	60	83
Reading Comprehension and Vocabulary	65	98
English as a Second Language	13	11
foreign Language	54	35
Other	9	13
Mathematics		
Pre-Algebra	36	82
Algebra I	69	96
Algebra II	81	95
Geometry	80	95
Precalculus	80	80
Calculus	52	58
Statistics[c]	17	[c]
Trigonometry[c]	7	[c]
Other	9	24
Computers		
Programming	43	47
Applications/Software Use	85	79
internet/Web Page Design[c]	7	[c]
Other	7	6
Science		
Physics	76	63
Biology	87	89
Chemistry	81	81
Earth Science	48	66
Other	15	19
Social Science/History		
History	11	47
Geography	9	24
Sociology	4	17
Psychology	8	15
Government/Civics	9	40
Other	8	13
Electives/Non-Academic Courses		
Performing Arts	31	53
Art	26	53
Journalism	28	52
Speech/Public Speaking	48	59
Physical Fitness	56	69
Other	6	26

[a] UBMS projects offer instruction in many areas besides math and science, either to meet regulatory requirements or simply to ensure that their program will interest and benefit students in many ways.

[b] 1992 non-bridge summer programs or 1992-93 academic year.

[c] Neither survey listed statistics, trigonometry, or internet or Web page design, but enough project directors specified them under "other courses" that we present data on these courses separately.

SOURCES: 1998 survey of UBMS projects, Fasciano and Jacobson (1997:39).

Exhibit II.10

Noninstructional Services Offered by UBMS Projects

	UBMS Summer 1994	Regular Upward Bound 1992[a]
College preparation/skills		
Campus visits	74%	98%
Adjusting to college living	98	92
ACT/SAT preparation	65	97
PSAT/PLAN or PACT preparation	24	73
Help with financial aid or scholarships[b]	80	100
Assistance with college applications	78	99
Assistance with financial aid applications	72	100
Career/employment assistance		
Site visits to employers[c]	65	59
On-campus (employers or career representatives)	63	78
Project-related work experience		49[d]
JTPA job	0	[d]
Work-study job	4	[d]
Math or science internships	24	[d]
Job through other partnerships	7	[d]
Field trips to		
Academic science or math facilities	98	[e]
Non-academic science or math facilities	94	[e]
Conduct math- or science-related field work	85	[e]
Other	93	[e]

[a]1992 nonbridge summer programs or 1992-93 academic year.
[b] In the regular Upward Bound grantee survey, this item was phrased, "Identify sources of financial aid."
[c] In the regular Upward Bound grantee survey, this item was phrased, "Site visit to employers or job shadowing."
[d]Although the regular Upward Bound grantee survey had three separate items about JTPA, work-study and other partnerships, the results were reported only in the aggregate, and it did not ask about math or science internships (Fasciano and Jacobson 1997:54).
[e]the regular Upward Bound grantee survey asked about field trips of varying lengths, not the destinations.

SOURCES: 1998 survey of UBMS projects, Fasciano and Jacobson (1997:54).

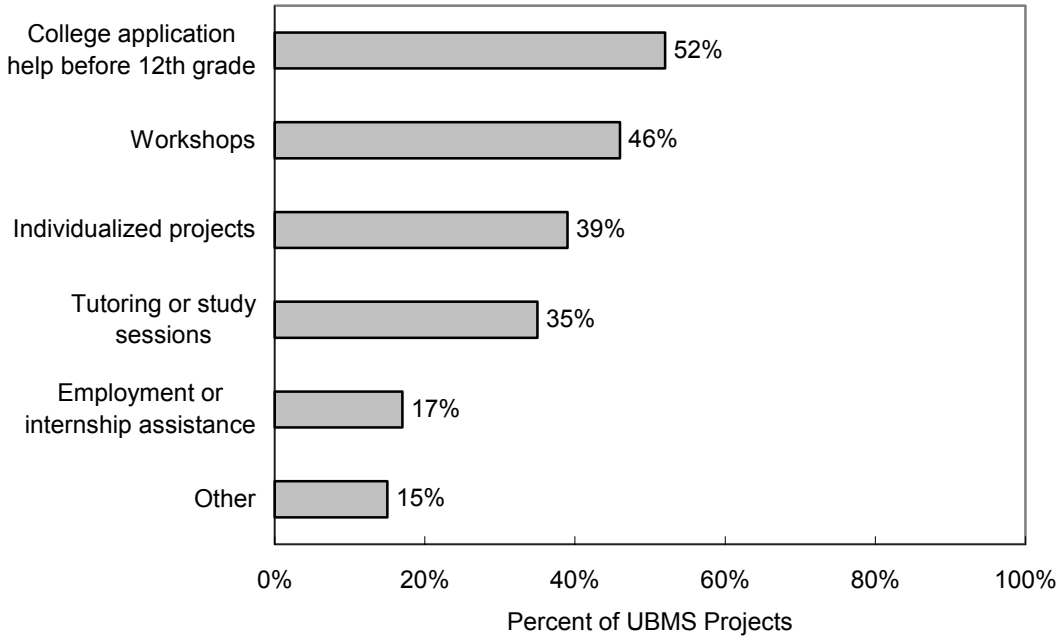
have reasonably expected that those other programs were assisting students in preparing for college.

5. Academic-Year offerings

While UBMS projects also provided services to students during the academic year in the mid-1990s, these services were minimal compared to UBMS summer services and also typically far less numerous and less intense than academic year services provided in regular Upward Bound. During the 1994-95 academic year, about one-third of UBMS projects provided tutoring or study sessions, and just over half provided assistance with college applications (see Exhibit

Exhibit II.11

Academic Year Services Offered by UBMS Projects, 1994-95



SOURCE: 1998 survey of UBMS projects.

II.11). The average UBMS project provided about three types of these services during 1994-95.[24] Not surprisingly, geographic proximity to their participating students influenced whether UBMS projects provided certain services during the academic year. UBMS projects were substantially more likely to provide tutoring and workshops during the academic year if a relatively large percentage of their participants lived in the same city or town as the program host.[25]

6. Instructional Approaches

In 1994, the most common instructional approach taken by UBMS projects was the provision of instruction through courses in separate subjects. Four out of five UBMS projects offered courses in separate subjects (see Exhibit II.12, Panel A). In three out of four UBMS projects, the primary method of instruction was either the provision of these courses (37 percent)

[24] By 1998-99, the percentage of UBMS projects regularly providing these services had increased substantially. For example, the percentage providing tutoring or study sessions rose from 81 percent to 93 percent, and the percentage providing assistance with college applications rose from 52 percent to 78 percent. This probably reflects the establishment of more locally oriented UBMS projects.

[25] For example, more than three-quarters of UBMS projects with a relatively large percentage of participants from the local area (above the median) offered tutoring during the academic year, versus less than half of UBMS projects with a relatively small percentage (below the median).

or the combination of these courses with interdisciplinary courses (also 37 percent, see Exhibit II.12, Panel B).

However, UBMS projects frequently employed other instructional methods. The majority of projects (63 percent) offered interdisciplinary courses, and in a large minority (35 percent), at least some students worked on a large project or experiment that spanned multiple academic subject areas (see Exhibit II.12, Panel A).

UBMS projects vary considerably in how they sort students into classes or groups. in the summer of 1994, about half of projects placed their students in instructional groups based on proficiency level (37 percent) or grade level (16 percent). About one-fourth placed students with diverse proficiency levels in the same group to facilitate learning (presumably the learning of less proficient students), and the remaining projects grouped students by their interests or in some other way.

UBMS participants do not spend most of their time in traditional lecture-style classes. At the average project during the summer of 1994, only one-fourth of the time was spent in lecture-style classes like those offered in most schools. The remaining time was spent in small group, teacher-led instruction (32 percent), laboratories (29 percent), computer-based instruction (12 percent), and other settings (4 percent).

D. INTENSITY AND QUANTITY OF SERVICES

The services that UBMS projects offer and the length of their summer residential summer programs suggest that these projects offer intensive programs that provide students with a "large dose" of services, at least for one summer. Furthermore, larger doses of effective services may yield larger impacts than smaller doses, as we found for regular Upward Bound (Myers et al. 2004). Summary measures of program intensity presented in this section indicate that UBMS projects offer an intensive program that might be expected to improve the math and science preparation of program participants.

UBMS is a resource-intensive program. Program grants to UBMS projects provided an average of approximately $4,800 per student in FY 2004 (see Exhibit II.13). This is comparable to funding for regular Upward Bound—approximately $4,500 per student—and much more expensive than most precollege programs. UBMS funding supports an extensive package of instruction and services, as described earlier in the chapter.

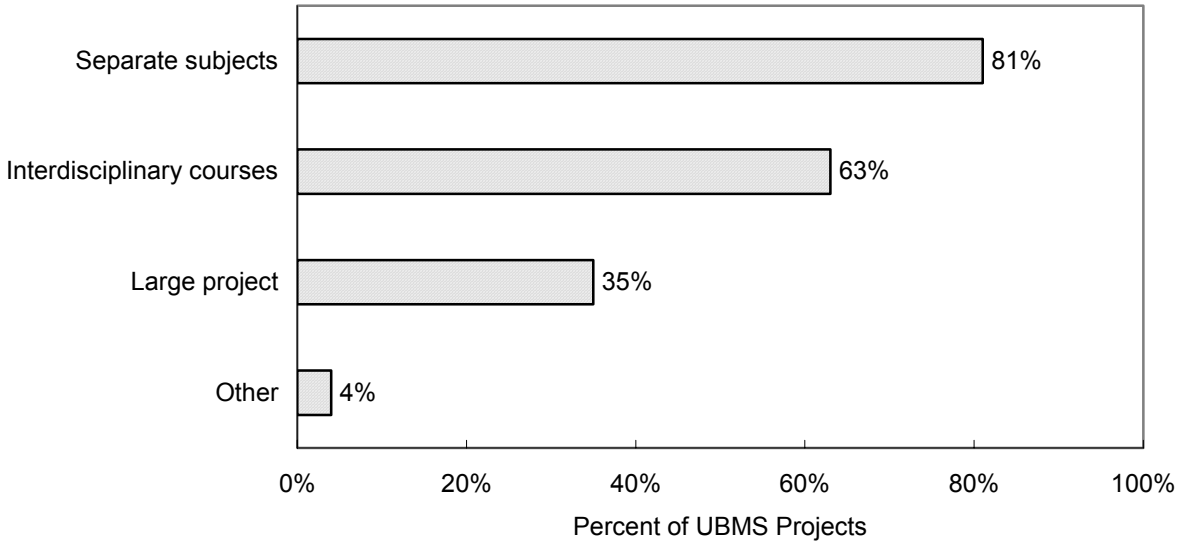
Participants devote a substantial amount of time to the program, and most of this time is spent on academics. At the average UBMS project in the summer of 1994, students spent about 29 hours per week receiving instruction and almost 11 hours per week on tutoring and homework. Thus, participating in UBMS over the summer is somewhat like having a full-time job requiring 40 hours per week. Because the vast majority of UBMS summer programs last six weeks,[26] participants at the average project spend 240 total hours on academics during the summer.

[26] Only five UBMS projects reported a program of a different length—three had a five-week session, one had a seven-week session, and one had an eight-week session.

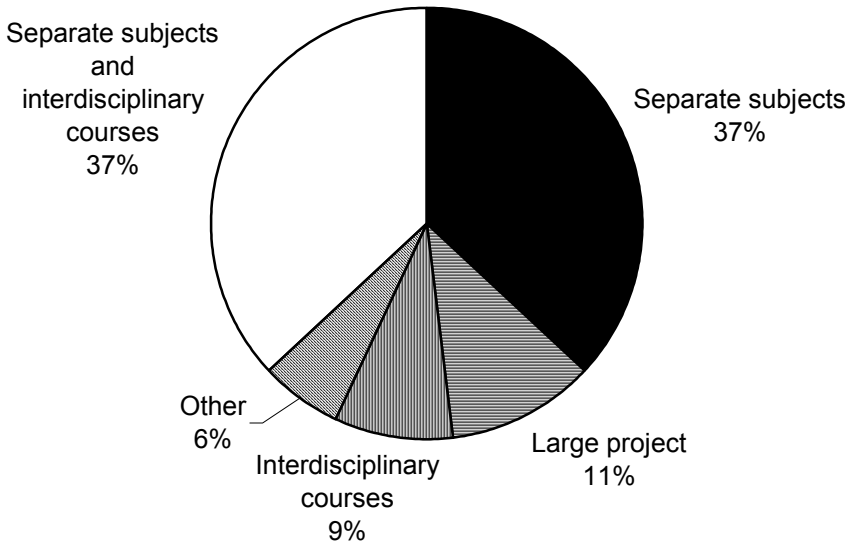
Exhibit II.12

Instructional Methods Used by UBMS Projects, 1994

A. Use of Different Instructional Methods



B. Primary Method Used



NOTE: Percentages may not sum to 100 percent due to rounding.
SOURCE: 1998 survey of UBMS projects.

Exhibit II.13

Per-Capita Funding for UBMS Projects, FY 2004

SOURCE: U.S. Department of Education Web page (www.ed.gov/programs/triomathsci/funding.html and www.ed.gov/programs/trioupbound/funding.html accessed June 2006).

The amount of time devoted to core program activities varied across UBMS projects. For example, four projects reported that students spent over 40 hours per week in instruction alone, while a handful of projects reported estimates of less than 10 hours per week. Estimates of time spent on tutoring or homework ranged from 0 to 20 hours per week. And the estimates of average total time spent on academics during the summer varied considerably, from under 100 hours at some projects to over 340 hours at some others.

Most UBMS participants seem to stay for the entire summer. At the average project in the summer of 1994, 94 percent of participants completed all the requirements of the program. A few projects reported completion rates of 50 percent or less, but this does not necessarily indicate a high dropout rate. Students might have attended the summer program for its full length but be counted as failing to "complete all the requirements of the program"—the wording in the questionnaire—because they did not, for example, turn in all their assignments.

Some students participate for multiple summers or receive services during the academic year. As indicated earlier, about 70 percent of UBMS projects operating in summer 1994 allowed students to return from the previous summer. Among those projects, an average of 35 percent of 1994 participants had also participated during 1993.[27] Furthermore, some UBMS projects extended students' exposure to the program beyond the summer by providing services during the academic year (see Section C.4 for more details).

[27] In summer 1998, not only did more UBMS projects (over 90 percent) allow students to return, but at those projects an average of 52 percent of students had also participated in summer 1997.

III. THE IMPACTS OF THE UPWARD BOUND MATH-SCIENCE PROGRAM

UBMS was established to increase economically disadvantaged students' achievement in high school math and science courses, to increase the likelihood that they would major in math and science in college, and ultimately to increase their representation in math and science careers. Until now, no rigorous studies have measured the extent to which the program achieves its goals. In this chapter, we assess the effects of UBMS on important outcomes for program participants four to eight years after graduating from high school.

This chapter presents our estimates of the effects of UBMS on (1) high school preparation for college and for majoring in math and science; (2) college enrollment, highest level of college attended, college selectivity, years of college completed and highest degree earned; and (3) field of study in college. These estimates are based on information collected in 2002 or earlier, and another round of data collection is currently underway. Given many students in our sample may have, for example, selected a major or completed a degree between 2002 and 2004, the findings in this report should be treated as an initial assessment of the effects of the program. Our final assessment will be based on the data collected in 2004.

The evidence suggests that in addition to improving students' grades in high school, UBMS increases the likelihood of:

- Taking chemistry and physics in high school
- Enrolling in more selective four-year colleges and universities
- Completing a postsecondary degree in a math and science field

The effects of UBMS are nontrivial and in the expected direction. For example, UBMS increased the likelihood of earning a bachelor's degree in a math or science field four to eight years after high school graduation from 12 percent to 20 percent. in the next report on UBMS, we will weigh the size of the program's benefits against its costs.

Because UBMS participants in our sample were not randomly selected to participate in the program, the impact estimates presented in this chapter may suffer from selection bias. However, in designing the study, we identified several likely sources of bias and have addressed them through a combination of data collection and statistical methods described later in the chapter. Therefore, the research design is stronger than in the typical nonexperimental study, and as a result, the impact estimates should be more credible.

A. STUDY DESIGN

UBMS provides intensive academic enrichment in math and science. Like regular Upward Bound projects, most UBMS projects also offer some assistance in preparing for college, such as assistance with college applications (see Chapter II for more details). The combination of

intensive academic enrichment in math and science with college preparation assistance suggests that UBMS might have positive effects on the following outcomes for program participants: (1) performance in high school, especially in math and science courses; (2) postsecondary attendance, persistence, and completion; and (3) the likelihood of completing a postsecondary degree in a math and science field. Therefore, we designed the analysis to answer the following three research questions:

1. What are the effects of UBMS participation on student performance in high school overall and in math and science courses in particular?
2. What are the effects of UBMS participation on college attendance, attendance at different types of colleges and universities, years of college, and college completion?
3. What are the effects of UBMS participation on the likelihood of completing a degree in math or science?

We have designed the analysis to measure the impacts of UBMS on two important subgroups: students who had previously participated in regular Upward Bound and students who had not participated. UBMS participants who previously participated in regular Upward Bound may have received a large dose of precollege services and academic preparation before participating in UBMS. However, most of the other UBMS participants entered UBMS without having received such intensive services. It is reasonable to expect UBMS to have larger effects on the students who had not previously received intensive services: students who have already received them may have already received the boost they needed to succeed. On the other hand, UBMS participants may be better prepared to benefit from their participation if they have previously participated in intensive services. in our analysis, we compute the effects separately for students who had previously participated in regular Upward Bound and students who had not participated to assess whether the effects of UBMS depend on the amount of precollege services students have received to that point. Regular Upward Bound is just one of the other programs in which UBMS participants could have participated. However, in our analysis, regular Upward Bound deserves special consideration because many UBMS participants participate in regular Upward Bound, and because few other programs are as intensive as UBMS.[28]

It is important to clarify we have not attempted to measure the effects of UBMS versus no precollege services. The analysis was designed to measure the effects of participating in UBMS relative to what students would have participated in otherwise—which might include regular Upward Bound—*not* the effects of participating in UBMS relative to no program participation. Most UBMS participants in our sample did not participate in regular Upward Bound, and only a few other precollege programs are as intensive as Upward Bound. Therefore, most UBMS participants would have participated in less intensive precollege services if they had not participated in UBMS.

[28] Moore (1997), Appendix A includes a list of 28 alternative math and science precollege programs. However, some other precollege programs without a specific precollege focus, such as regular Upward Bound, may share some common features with UBMS. Annual per student costs were available for 17 of the 28 programs; of these 17, only two were more expensive per student-year than UBMS.

In this section, we describe the design of the analysis used to measure the impacts of UBMS. The impact analysis is based on a matched comparison group that attempts to reduce two types of bias common to many nonexperimental studies: selection bias and bias attributable to different data collection protocols for the participant and comparison groups. The strength of the impact analysis rests on three features of its design:

1. How we selected our initial samples, particularly the comparison sample
2. How we collected "baseline" (preprogram) information on the two samples
3. How we used that information to select a matched comparison group

In the remainder of this section, we describe these three features of the study and our approach to estimating the effects of UBMS on student participants.

1. Selecting the Samples

For the impact analysis, we obtained our sample of program participants from the projects themselves. In 1998, we contacted the 62 Upward Bound Math and Science Centers (MSCs) that were operating at that time and that had been operating between 1993 and 1995.[29] From these MSCs, we requested lists of the students who had participated in their program in the summer of 1993, the summer of 1994 or the summer of 1995.[30] To reduce the costs of collecting the necessary data, we selected one out of every four of the students from these lists for our analysis sample.

A primary feature of any nonexperimental evaluation is the choice of a comparison group. Experiments yield the best comparison groups because differences in outcomes between treated and untreated cases cannot be attributed to selection bias. In the absence of an experiment, the strength of an evaluation depends on the comparability between the participant and comparison groups.

The most convenient comparison group for the impact analysis is also a compelling one—and the one we used. For the comparison group, we selected students from the evaluation of regular Upward Bound who reported that they had not participated in an MSC.[31] In doing, so, we selected a comparison group with three desirable attributes:

[29] While we would have been interested in obtaining lists of students from projects that were no longer operating in 1998, we believed that it would be very difficult to obtain such lists. If MSCs that closed before 1998 operated less effective programs than those that remained open, then the results presented in this chapter may overstate the effectiveness of MSCs operating between 1993 and 1995.

[30] We received participant lists from all but one of these MSCs.

[31] If UBMS projects admitted eligible applicants on a fairly random basis, rejected applicants would probably constitute the best comparison group. However, MSCs are not required to select randomly from eligible applicants, and the evidence suggests that they do not. Case studies of 14 MSCs in the mid-1990s suggest that many MSCs

1. ***Like UBMS participants, comparison students applied to participate in Upward Bound.*** Therefore, both UBMS participants and comparison students revealed a high level of motivation to pursue precollege services. This provides some protection against a common source of selection bias in nonexperimental studies—bias from comparing more motivated participants to less motivated nonparticipants.

2. ***Like UBMS participants, comparison students met the federal eligibility requirements to participate in some type of Upward Bound program—regular or math and science.*** The federal eligibility requirements are the same for both regular Upward Bound and UBMS. To be included in the sample for the evaluation of regular Upward Bound—the sample from which we selected our comparison group—a student must have applied to a regular Upward Bound project and been determined eligible to participate. Therefore, both UBMS participants and comparison students in our sample must either have come from "low-income" families (income below 150 percent of the poverty line) or potential "first-generation" families (neither parent had earned a bachelor's degree).

3. ***Like UBMS participants, many comparison students would have met project-specific eligibility requirements imposed by some MSCs.*** Moore (1997) indicates that MSCs often apply additional admissions criteria in selecting applicants—criteria that include a minimum grade point average (GPA) in math and science. in this chapter, we show that many comparison students met the same criteria: many were successfully "matched" to UBMS participants who took similar courses and earned similar grades in math and science in ninth grade.

While the regular Upward Bound sample is a useful comparison group for measuring the effects of UBMS, it is not a perfect one. Data from the 1990s suggest that MSCs typically had more stringent minimum GPA requirements than regular Upward Bound projects; and MSC staff—who typically had recent experience with regular Upward Bound participants—reported that UBMS participants tended to be "more serious about school" than regular Upward Bound participants (Moore 1997, p. 26). Therefore, UBMS participants might fare better than regular Upward Bound participants even without any assistance from UBMS, and simple differences in mean outcomes between the UBMS participant and comparison groups may overstate the effects of UBMS due to selection bias.

To reduce selection bias, we selected a matched comparison sample from the regular Upward Bound sample. More specifically, we matched each UBMS participant to one or more

(continued)

impose additional eligibility requirements beyond the federal requirements, including an interest in math and science (Moore 1997). Therefore, it is unlikely that rejected applicants would have the virtues of a randomly selected control group for the purposes of this evaluation. Furthermore, the difficulty in obtaining lists of program participants from MSCs several years after they participated in UBMS suggests that many MSCs would not have been able to provide information on rejected eligible applicants.

regular Upward Bound sample members with similar characteristics based on data collected from student surveys and transcripts.[32] See Section 3 for more details.

2. Collecting Baseline Data

The baseline variables constructed for the impact analysis characterize members of the two samples early in high school before UBMS participants in our sample entered UBMS. These variables are critical because they allow us to account—through a combination of matching and regression adjustments—for many preexisting differences between the two groups that might otherwise bias our impact estimates. To collect the information necessary to create baseline variables, we conducted student surveys and collected high school transcripts (see Appendix A).

An important strength of the study's design is that the data collection strategy was similar for both samples. Heckman et. al. (1997) argue that different survey questionnaires for the participant and comparison samples can be an important source of bias in nonexperimental studies. In this evaluation, we developed the initial survey questionnaire for UBMS participants from the baseline survey questionnaire for the regular Upward Bound sample. Therefore, the survey questions from which we constructed baseline variables were often identical and always similar for the two samples.[33] Furthermore, the approach to collecting and coding high school transcripts was the same for the two samples. Therefore, it is unlikely that differences in the data between the two samples have biased the impact estimates presented in this chapter.

The baseline variables for the impact analysis fall into the following three categories: (1) demographic and family characteristics, (2) participation in other precollege programs and (3) ninth-grade academic achievement in math and sciences and more generally (see Exhibit III.1). We believe that the measures of students' ninth-grade academic achievement are critical to the strength of the study. Given the findings in earlier reports, it seems entirely possible that even among students with similar demographic and family characteristics, students who participated in UBMS might have a higher academic aptitude and interest in math and science than students who participated in regular Upward Bound. Therefore, we use information on ninth-grade courses taken and ninth-grade grade point average—overall and specifically math and science—to control for differences between the two samples in early high school achievement.

[32] Very few of students in the regular Upward Bound sample participated in UBMS, and those who reported participating in UBMS were excluded from the comparison group.

[33] Two differences in the two surveys were addressed in constructing baseline variables for the MSC impact analysis: (1) the two survey questionnaires were different, and (2) the surveys were conducted at different times—after high school for the participant group and early in high school for the comparison group. To address the differences in the survey questionnaires, we used data from survey questions that are either identical or almost identical. To address the difference in the timing of the surveys, we used data from survey questions only when the timing of the survey was unlikely to affect the answer to the question.

Exhibit III.1

Baseline Variables

Category	Variables	Source
Demographic and family	Sex Race and ethnicity Census region Native English speaker Mother's time in the U.S. Sibling participated in Upward Bound High school cohort	Initial surveys
Prior program participation	Sample member participated in regular Upward Bound	Initial survey and project records
Ninth-grade achievement	GPA in math and science GPA in other subjects Math course taken Science course taken	High school transcripts

NOTE: The initial surveys were conducted in 1999 for UBMS participants and in 1992-94 for comparison students in the regular Upward Bound sample. To identify UBMS participants who had previously participated in regular Upward Bound, we used responses to the 1999 initial survey; to identify comparison students who participated in regular Upward Bound, we used participation information provided by projects. We collected high school transcripts in 2000 and 2003 for UBMS participants and in 2000 and earlier years for comparison students.

3. Selecting a Matched Comparison Sample for the Impact Analysis

The data collected on UBMS participants and regular Upward Bound sample members are useful in identifying many similarities between the two groups—and some differences as well (see Exhibit III.2). In both groups, 37 percent of the students were African American and 11 percent had a sibling who had participated in Upward Bound. The two groups were similar with respect to many other characteristics as well, including the percentage taking algebra in ninth grade. However, the two groups exhibit differences on several dimensions. For example, UBMS participants were more likely to be male and tended to have higher grades than regular Upward Bound sample members.

To address possible selection bias, we selected a matched comparison group from the regular Upward Bound sample using propensity score matching methods.[34] The goal in

[34] Many studies adjust for baseline differences of these types using standard covariance adjustments—that is, by controlling for these variables in a regression analysis. However, the differences between the UBMS participant sample and the regular Upward Bound sample are too large to expect covariance adjustment to be reliable. Regression adjustments are likely to be unreliable if the means of the propensity scores are more than half a standard deviation apart (Rubin 2002). For the participant sample, the mean and standard deviation of the propensity score are 0.58 and 0.22, respectively; for the comparison sample, the mean and standard deviation of the propensity score are 0.25 and 0.23, respectively. Therefore, the difference in mean propensity scores is more than one standard deviation, and regression adjustments alone are likely to be unreliable.

Exhibit III.2

Summary Statistics from the Baseline Variables
(Percentage unless otherwise noted)

Characteristic	UBMS Participants	Regular Upward Bound Sample	Matched Comparison Group
Participated in Regular Upward Bound	18	55***	18
Female	59	72***	59
Race and Ethnicity			
African American	37	37	37
White	25	34***	30
Hispanic	18	20	16
Other race	20	9***	17
Region			
Northeast	11	9	12
Midwest	23	19**	28
South	40	45**	35
West	25	26	24
Entry to High School			
1991-92	32	25***	28
1992-93	39	49***	37
1993-94	29	26	35
Other Characteristics			
Native English speaker	80	87***	86**
Mother in U.S. most of her life	79	87***	83*
Siblings in Upward Bound	11	11	12
Ninth-Grade Math Course			
Lower than algebra	16	32***	14
Algebra	55	53	59
More than algebra	29	14***	27
Ninth-Grade Science Course			
Biology, chemistry, or physics	37	26***	37
Ninth-Grade GPA (mean)			
Math and science	2.69	1.65***	2.71
Other subjects	3.24	2.64***	3.25

*/**/*** Significantly different from UBMS participants at the 0.10 / 0.05 / 0.01 level.

matching was to select a matched comparison sample from the regular Upward Bound sample such that the distributions of the baseline variables for the UBMS participant sample and the matched comparison sample were similar.[35] Matching was conducted separately for sample members who had previously participated in regular Upward Bound and for those that had not:

- UBMS participants who had previously participated in regular Upward Bound were matched to members of the treatment group in the evaluation of regular Upward Bound.
- UBMS participants who had not previously participated in regular Upward Bound were matched to regular Upward Bound control group members who did not participate in regular Upward Bound.

Regular Upward Bound sample members that were matched to at least one UBMS participant were included in the matched comparison sample. [36, 37]

Using matching procedures, we were able to select a matched comparison group that is highly similar to the sample of UBMS participants on many dimensions (see the last column of Exhibit III.2). Only two of the differences between the groups are statistically significant—the difference in the percentage of sample members who are native English speakers and the percentage whose mother has lived in the United States for all or almost all of her life. Furthermore, given the number of baseline variables, two is a small number of significant differences: we would expect about two significant differences even if the differences between the two groups were purely random. While there is no guarantee that matching removed all unmeasured differences between the two samples, matching removed differences on a broad range of baseline variables—differences that might otherwise bias the impact estimates.

[35] More specifically, the goal is to ensure that the distributions of the baseline variables for the UBMS participant sample and the matched comparison sample are similar enough such that covariance adjustments will produce reliable impact estimates

[36] The propensity score matching and the impact analysis are restricted to sample members who entered high school between 1991 and 1993. While some UBMS participant sample members entered high school before 1991 and after 1993, relatively few comparison sample members did so. Furthermore, high school cohort is related to the likelihood of participating in the program and to the outcomes of interest because earlier cohorts had more time to enter college and select a field of study by the time they were interviewed for the evaluation. Therefore, to protect the internal validity of the study, we focused the analysis on students who entered high school between 1991 and 1993.

[37] UBMS participants could be matched to more than one regular Upward Bound sample member, and regular Upward Bound sample members could be matched to more than one UBMS participant. To be matched, a pair of students must satisfy the following condition: the difference between matched students in the log odds of the propensity scores was less than 0.20 times the standard deviation of the log odds. Smith and Todd (2003) refer to this type of matching as "radius matching."

4. Estimating the Impacts of UBMS Participation

To measure the effects of UBMS participation on participating students, we used a regression-based approach that allows us to (1) adjust for the small remaining differences between the UBMS participant sample and the matched comparison group and (2) increase the precision of our impact estimates. The regression models yield estimates of the effect of UBMS on students who participated in the program.[38]

We estimated the effects of UBMS for the entire sample and separately for selected subgroups of students. The effects of UBMS may depend on the amount of other precollege services received. Therefore, we present separate impact estimates for those who participated in regular Upward Bound and those who did not participate. Furthermore, we present separate estimates by sex and race since achievement in math and science often varies along these dimensions, and the effects of UBMS may vary along the same dimensions.[39,40]

B. ANALYSIS AND FINDINGS

In this section, we present the estimated effects of UBMS on students' outcomes. Consistent with program objectives, participation in UBMS seems to promote postsecondary study in math and science. Specifically, our estimates suggest that UBMS participation (1) raises grades in high school and course-taking in chemistry and physics, (2) increases enrollment in more selective four-year institutions and the number of years of college completed, and (3) raises the likelihood of both pursuing postsecondary studies and completing a four-year degree in math or science. In contrast, UBMS does not affect course-taking in advanced math in high school.

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[38] We regressed each outcome on a set of control variables and an indicator of whether the student participated in UBMS. The control variables included the variables used in selecting the matched comparison group: prior participation in regular Upward Bound, siblings in Upward Bound, sex, race, ethnicity, mother's native language and immigrant status, high school cohort, region of the country, and several variables describing academic achievement in ninth grade, including GPA—separately for math and science courses and for other courses—math course taken, and science course taken. For continuous variables, such as number of college credits, we estimated linear regression models; for categorical outcomes, such as whether the sample member pursued postsecondary studies in math or science, we estimated logistic regression models or "logit" models. In estimating standard errors, we accounted for clustering by project and used the Taylor series linearization methods employed by the SUDAAN statistical analysis software.

[39] Other reports from the National Evaluation of Upward Bound have shown that the effects of regular Upward Bound vary with the educational expectations of student applicants (see Myers et al. 2004 and Myers and Schirm 1999). In particular, regular Upward Bound greatly increased the likelihood of attending a four-year college or university for students who did not expect to earn a bachelor's degree when they applied to participate in regular Upward Bound. Because we first interviewed UBMS participants after they finished participating in UBMS, we lack information on their educational expectations when they applied to participate in UBMS. Therefore, we cannot assess whether the effects of UBMS vary with students' educational expectations before participating.

[40] In the national evaluation, we have estimated the effects of regular Upward Bound separately by eligibility category (low-income, first-generation, or both). However, student data was provided by project directors when they submitted students to Mathematica for random assignment. Because we did not conduct random assignment for the evaluation of UBMS, we lack data on eligibility for UBMS participants. While we did obtain rosters of prior participants from UBMS projects in 1998, we did not request data on eligibility because we did not believe that projects could easily provide them for students who participated three or more years ago.

1. The Effect of UBMS on High School Outcomes

The UBMS program is designed to strengthen participants' math and science skills. MPR conducted follow-up student surveys and collected high school transcripts to determine whether UBMS participation increased the amount of course work in math and science as well as total high school credits, high school graduation and GPA in math and science and overall.[41]

UBMS raised the likelihood of taking upper-level high school courses in science but not in math (see Exhibit III.3). Our estimates indicate that UBMS increased the likelihood of taking upper-level science courses in high school, raising the percentage of students taking chemistry from 78 to 88 percent and raising the percentage of students taking physics from 43 to 58 percent.[42] The estimated effects of UBMS on the likelihood of taking algebra II, trigonometry, precalculus and calculus are statistically insignificant.

It is not clear why UBMS affected course-taking in the sciences but not in math. One possibility involves differences between the type of instruction that MSCs offer in math and the type of instruction they offer in sciences. Almost two-thirds of MSCs reported offering interdisciplinary classes, and about a third of them offered instruction that revolved around a large project or experiment (see Chapter II). However, findings from Moore (1997) suggest that in MSCs, laboratories and hands-on instruction were much more common in science instruction than in math instruction, and that MSC instructors used math to help student prepare for careers in science and technology (see Moore 1997, pp. 41-42). It is possible that the combination of hands-on instruction offered only in science with the science orientation of MSC instructors is responsible for UBMS's effects on science course-taking.

Additional estimates suggest UBMS raises overall achievement and educational attainment in high school (see Appendix B). UBMS had a positive effect on high school grades, increasing the average GPA in math courses from 2.7 to 2.8, the average GPA in science courses from 2.7 to 2.9 and the average GPA overall. It also raised the graduation rate from 96 to 99 percent.

UBMS appears to have had larger effects on grades and science course work for Hispanics than for African Americans (see Appendix B). For example, UBMS raised the average GPA in math courses from 2.4 to 2.5 for African Americans and from 2.4 to 2.7 for Hispanics. In addition, UBMS raised the likelihood of taking chemistry and physics by 7 percentage points each for African Americans and by 17 and 27 percentage points, respectively, for Hispanics.[43] Comparisons of males to females and students who had participated in regular Upward Bound to other students revealed few significant differences.

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[41] With the exception of the outcome variables describing high school completion, which were constructed from student survey responses, the high school outcomes were constructed using data from high school transcripts.

[42] These increases in part reflect increases in the total number of courses taken in high school: UBMS raised the average number of high school credits earned from 25 to 26.

[43] For African Americans, the estimated effect on the likelihood of taking physics was not statistically significant.

Exhibit III.3

Math and Science Courses Taken in High School
(Percentage of students)

	UBMS Participants	Matched Comparison Group	Impact
Math Courses			
Algebra	97	97	0
Geometry	86	86	0
Algebra II	73	74	-1
Trigonometry	35	30	5
Analysis or Precalculus	36	31	5
Calculus	26	24	2
Science Courses			
Biology	97	98	-1
Chemistry	88	78	10***
Physics	58	43	15***

*/**/*** Statistically significant at the 0.1 / 0.05 / 0.01 level.

NOTES: Impact may not exactly equal the difference between UBMS participants and the matched comparison group due to rounding. See Table B.1 in Appendix B for more details and additional high school outcomes and Tables B.2 through B.4 for estimates for subgroups of UBMS participants.

2. The Effect of UBMS on Postsecondary Attendance, Persistence, and Completion

While UBMS focuses on preparing students to major in math and science and to complete a degree in a math and science field, a person must enroll in college before choosing a major and must complete college to earn a degree in a math and science field. Even if UBMS had little effect on students' choice of major, UBMS might be a cost-effective strategy to increase college enrollment and completion for disadvantaged students. Therefore, we assess whether UBMS promotes postsecondary attendance, persistence, and completion before examining its effects on college major.

The evidence suggests that UBMS participation increases the likelihood of attending a postsecondary institution. Estimates for the matched comparison group suggest that 90 percent of UBMS participants would have attended a postsecondary institution if they had not participated in UBMS (see Exhibit III.4). This indicates that UBMS participants are much more likely to attend college than the average low-income high school student, and a 90-percent attendance rate leaves little room for improvement. Despite this, the evidence suggests that UBMS participation increases the likelihood of attending a postsecondary institution from 90 to 95 percent, although as shown in Appendix C, this result is sensitive to how postsecondary

Exhibit III.4

Postsecondary Attendance, Highest Level Attended and College Selectivity
(Percentage of students)

	UBMS Participants	Matched Comparison Group	Impact
Postsecondary Attendance	95	90	5***
Highest Level Attended			
Four-year college or university	82	71	11***
Two-year college	11	16	-5***
Vocational institution	2	4	-2
Most Selective Four-Year institution			
More selective	33	23	11
Less selective	48	48	0

*/**/*** Statistically significant at the 0.1 / 0.05 / 0.01 level.

NOTES: Impact may not exactly equal the difference between UBMS Participants and the Matched Comparison Group due to rounding. "Most Selective College or University" refers to four-year colleges and universities only, and some four-year institutions were not classified in *Barron's Profiles of American Colleges* (2003). See Table B.5 in Appendix B for more details and additional postsecondary outcomes and Tables B.6 through B.8 for estimates for subgroups of UBMS participants.

attendance is measured and, specifically, to whether college transcripts are used to verify attendance.[44]

The evidence also suggests that UBMS participation increases the likelihood of attending a four-year college or university from 71 percent to 82 percent. The increase in four-year attendance can be attributed to increased attendance at more selective schools as UBMS raises the likelihood of attending such a school from 23 to 33 percent.[45] It appears that some of this

[44] This 95-percent figure suggests that almost all UBMS participants attend a postsecondary institution in the first few years after high school. In contrast, findings from a recent analysis of performance data submitted by UBMS projects seem to suggest a much lower rate of postsecondary attendance. Analyzing the performance data, Curtin and Cahalan (2004) find that only 68 percent of UBMS participants who graduated from high school in 1999-2000 were reported as attending a postsecondary institution in 2000-01. The difference between this figure and the enrollment rate presented in this report reflects substantial differences in how the two estimates were derived. According to information provided to us by ED, the estimate in Curtin and Cahalan (2004) indicates the percentage of former program participants for whom UBMS project directors could confirm postsecondary attendance. The estimate was not intended to measure the postsecondary enrollment rate per se, and it understates the true rate for UBMS participants for two related reasons. First, the estimate includes in the denominator but not the numerator UBMS participants from projects that were no longer funded and, therefore, did not submit performance data. Second, it excludes from the numerator about one-fifth of the participants who are included in the denominator because UBMS project staff were unable to confirm college attendance for these former participants. For our estimate, in contrast, we exclude from both the numerator and denominator the UBMS participants in our sample for whom we are missing data due to survey nonresponse and, then, use standard weighting techniques to adjust for the missing observations.

[45] If a school was rated as "most competitive," "highly competitive," or "very competitive," then we classified the school as "more selective." If a school was rated as "competitive," "less competitive," "noncompetitive," or

increase in four-year college enrollment can be attributed to students who would otherwise have attended only two-year colleges: UBMS reduced the likelihood of enrolling in a two-year college but not in a four-year college or university from 16 to 11 percent.

UBMS increased the number of years that students spend in four-year colleges and universities without increasing the completion rate at these schools. Our estimates suggest UBMS increased the number of years enrolled in a four-year institution from 2.4 to 2.9 (see Exhibit III.5). While UBMS increased the amount of time participants spent in college, it had no effect on the likelihood of their completing a bachelor's degree as of the time we last interviewed them in 2002. Given that almost half of UBMS participants in our sample (47 percent) were attending four-year colleges and universities when we last interviewed them, it is too early to reach firm conclusions about the effects of UBMS on the number of years of college attended and on college completion. Our final report on the Upward Bound Math-Science Program will be based on data collected in 2004.

The average effects of UBMS mask some interesting differences between men and women. for both men and women, UBMS increased the percentage attending a selective four-year institution—from 23 to 34 percent for men and from 21 to 32 percent for women. However, UBMS only affected overall four-year enrollment for women. For women, UBMS increased the likelihood of attending a four-year institution from 68 to 82 percent and reduced the likelihood of attending a two-year institution (without also attending a four-year institution) from 18 percent to 10 percent; for men, both of these effects were statistically insignificant.

The effects on college completion also differ between men and women. For women, the positive effect of UBMS on enrollment in four-year institutions—along with positive effects on credits earned in these institutions—translates into higher graduation rates from four-year institutions. UBMS raised the percentage of women earning a bachelor's degree from 32 to 40 percent. For men, the effect of UBMS on the percentage completing a bachelor's degree is statistically insignificant; however, UBMS increased the percentage completing an associate's degree from 4 to 8 percent.

In the last report from the national evaluation (Myers et al. 2004), we presented two sets of estimates for postsecondary attendance and highest level attended—the first based entirely on the information reported by the student, and the second that required verification of enrollment from the institution. In computing the second set of estimates, we made the strong assumption that a student did not attend the school they reported to us unless we received verification from the school in the form of a college transcript (or a reason for not providing one that clearly indicated that the student had attended the school). However, additional analysis of the data suggests that in most cases for which we did not receive a transcript, there is no reason to doubt that the students actually attended the schools they reported. Schools provided a variety of reasons for

(continued)

"special," or the school was either excluded from Barron's or was included but not rated, then we classified the school as "less selective." Students were then classified as "more selective" school if they attended one or more of the "more selective" institutions, and "less selective" if they attended one or more of the "less selective" institutions and did not attend a "more selective" institution.

Exhibit III.5

Years of College and Degree Completion

	UBMS Participants	Matched Comparison Group	Impact
Years of College			
Four-year college or university	2.9	2.4	0.4**
Two-year college	0.4	0.4	0.0
Degree Completion (percent)			
Bachelor's degree	35	33	2
Associate's degree	7	7	-1

*/**/*** Statistically significant at the 0.1 / 0.05 / 0.01 level.

NOTES: The comparison group estimates and impact estimates are regression-adjusted (see Chapter III, Section A.4). Impact may not exactly equal the difference between UBMS Participants and the Matched Comparison Group due to rounding. Years of Postsecondary Education were computed by dividing the number of credits earned by 30. See Table B.5 in Appendix B for more details and additional postsecondary outcomes and Tables B.6 through B.8 for estimates for different subgroups of UBMS participants.

not providing transcripts, including confidentiality considerations and money that the student owed to the school. Therefore, for all outcome variables except years of college, which are based on information from college transcripts, the estimates presented in this chapter are based on the information reported by the students themselves. However, we conducted a sensitivity analysis to see whether requiring verification of enrollment affected our impact estimates, and in most cases, it did not. See Appendix C for more details about the sensitivity analysis.

3. The Effect of UBMS on Postsecondary Field of Study

The primary objective of UBMS is to prepare students for postsecondary studies in math and science. Using information reported by students in 2002, we conducted an analysis to examine whether UBMS participation increases the likelihood of pursuing postsecondary studies in math and science or the likelihood of earning a postsecondary degree in a math or science fields. To determine whether a sample member had pursued postsecondary studies in math and science, we asked sample members in the 2002 survey for their "most recent or intended field of study," and we classified their responses according to the same classification system used in the National Science Foundation's Scientists and Engineers Statistical Data System (SESTAT).[46] Furthermore, for the analysis, we separated the social sciences from other math and science fields (which we refer to as "math or science") because the objectives of the program are more closely tied to the latter than the former.

[46] The fields classified as science and engineering were biological sciences, computer science, engineering, mathematics, physical sciences, and technical fields. The fields classified as non-science and engineering were agriculture, arts, business, education, clerical or legal assistance, communications, health-related fields, humanities, trade and industry, protective services and consumer or personal services. A small number of fields reported by sample members could not be classified as either science and engineering or nonscience and engineering. (For more details about NSF's classification of fields of study, see www.nsf.gov/sbe/srs/nsf99337/pdf/appa.pdf.)

The evidence suggests that UBMS participation encourages students to pursue postsecondary studies in math or science and also in the social sciences. UBMS increased the likelihood of majoring or intending to major in math or science from 23 to 33 percent overall and from 18 to 28 percent if we focus on majors at four-year colleges and universities (see Exhibit III.6).[47] The effects are also positive but smaller in magnitude for the social sciences: UBMS increased the likelihood of pursuing postsecondary studies in the social sciences from 7 to 11 percent overall and from 7 to 10 percent if we focus on majors at four-year institutions.

The evidence also suggests that UBMS participation may encourage students to complete postsecondary degrees in math or science. However, with almost half of participants still in college, it is too early to reach final conclusions about UBMS's effects on college completion overall or in specific fields. As of the 2002 survey, the effect of UBMS on the likelihood of earning a degree or certificate in math and science was statistically insignificant. However, if we focus on four-year institutions, UBMS altered the types of fields in which students earned degrees. More specifically, it raised the likelihood of earning a bachelor's degree in math or science from 6 to 12 percent and reduced the likelihood of earning a bachelor's degree outside of math or science or the social sciences from 20 to 14 percent.

The effect of UBMS on the likelihood of majoring in math and science was larger for men than for women. While UBMS increased the likelihood of pursuing postsecondary studies in math and science from 38 to 58 percent for men, the estimated effect for women is much smaller and statistically insignificant. In contrast, there is no evidence that the effect of UBMS on the likelihood of completing a math or science degree differs between the two groups.

C. INTERPRETATION OF THE FINDINGS

The estimated effects of UBMS paint a fairly consistent picture of UBMS helping its participants onto an educational path that could lead to careers in math and science. Our findings suggest that UBMS participation improves student outcomes in high school and college, and—consistent with the objectives of the program—increases the odds of completing a college degree in math and science.

While we took several steps to reduce selection bias, it is certainly possible that the true effects of participating in UBMS are smaller than our estimates suggest. As reported earlier in the chapter, UBMS participants may be more serious about school than regular Upward Bound participants on average. This difference is reflected in our data: UBMS participants in our sample had higher GPAs and took more advanced math and science courses in ninth grade than members of the regular Upward Bound sample. We accounted for these differences by selecting a matched comparison group that resembled the UBMS participant sample in both grades earned and course-taking in ninth grade. However, it is possible that despite earning similar grades and taking similar courses early in high school, the UBMS participant sample is somewhat more serious about school, more serious about math and science, or is different from the matched comparison group in some other way that would lead our analysis to overstate the effects of UBMS.

[47] For convenience, we use the terms "major" and "field of study" interchangeably.

Exhibit III.6

Field of Study
(Percentage of students)

	UBMS Participants	Matched Comparison Group	Impact
All Postsecondary institutions			
Postsecondary Studies			
Math or science	33	23	10***
Social science	11	7	4*
Other	42	51	-9***
Postsecondary Studies Completed			
Math or science	15	12	3
Social science	8	4	3*
Other	21	28	-7**
Four-Year Colleges and Universities			
Postsecondary Studies			
Math or science	28	18	10***
Social science	10	7	4*
Other	36	39	-3
Postsecondary Studies Completed			
Math or science	12	6	6***
Social science	6	4	3
Other	14	20	-6**

*/**/*** Statistically significant at the 0.1 / 0.05 / 0.01 level.

NOTES: Impact may not exactly equal the difference between UBMS Participants and the Matched Comparison Group due to rounding. See Table B.9 in Appendix B for more details and additional outcomes and Tables B.10 through B.12 for estimates for subgroups of UBMS participants.

While we cannot measure the extent of selection bias, some informed speculation is helpful in interpreting the impact estimates. As we indicated earlier, students in both groups—the UBMS participant sample and the matched comparison group—exhibited some motivation to improve academically by applying to participate in Upward Bound. Therefore, motivational differences between the two groups are likely to be small and unlikely to bias the impact estimates. However, the impact estimates would overstate the true impacts if:

- ***Members of UBMS participant sample were higher achievers than members of matched comparison group.*** by the end of high school and after students in the UBMS sample had participated in UBMS, the average GPA was slightly but significantly higher for UBMS participants (3.14) than for matched comparison students (3.06). Even if the entire difference were attributable to selection bias instead of the effects of the program, the average student in each group was a B student. Therefore, if the UBMS participant sample contains higher achieving students than the matched comparison group, the difference seems to be small.

- ***Members of the UBMS participant sample were better at math and science than members of the matched comparison group.*** If students in the UBMS participant sample were better at math and science than students in the matched comparison group, it is not reflected in their math and science course-taking or grades during ninth grade: the two groups had similar grades in math and science, were equally likely to take algebra or geometry and were equally likely to take biology, chemistry or physics. While we did not explicitly examine whether UBMS participants were more likely to enroll in the advanced sections of courses before entering UBMS, other findings suggest that UBMS participants were no more likely to have taken Advanced Placement classes in math or science by the time they finished high school. Finally, focus groups conducted in 1996 suggest that UBMS participants do not view themselves as particular strong in math and science (Moore 1997, p. 28). Therefore, the information we have collected provides no reason to believe that when they entered UBMS, the participant sample was better at math and science than the matched comparison group.

- ***Members of the UBMS participant group were more interested in math and science than members of the matched comparison group.*** None of the information that we extracted from student transcripts would suggest that the UBMS participant sample had greater interest in math and science. It is possible UBMS participants had greater interest in careers in math and science that simply was not reflected in their high school course-taking or grades early in high school. in 1996 focus groups, many UBMS participants expressed interest in pursuing careers in scientific fields, such as engineering, medicine, and nursing (Moore 1997, p. 28). However, many of these students indicated that their career interests had developed just that summer, and the expression of those interests could have been influenced by the fact that the focus groups were conducted on site at projects that emphasized math and science.

We suspect that the impacts most vulnerable to selection bias are those that are most closely related to a person's interest in pursuing careers in a math or science field. To gauge students' interest in math and science early in high school would probably require conducting assessments or survey interviews at that time. However, we first interviewed members of the UBMS participant sample after they had completed high school. The possibility that UBMS participants might have had greater interest in pursuing a career in science than matched comparison students raises the question of whether our estimates overstate the effects of UBMS on the outcomes that are most closely related to one's career interests, such as majoring in math or science in college.

Therefore, while the findings in this report are promising, a note of caution is appropriate. We speculate that the selection bias is likely to be largest for outcome variables most closely tied one's interest in pursuing math and science careers, but it is not possible to measure the selection bias. While we took several steps to reduce selection bias, the estimated effects of UBMS may overstate the true effects of the program.

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APPENDIX A

DATA COLLECTION

This appendix describes and assesses the procedures for collecting the data that we used to construct student outcome measures for the impact analysis presented in Chapter III. These data come from two different sources:

1. The fourth follow-up survey of students

2. Secondary and postsecondary transcripts

This appendix focuses on procedures for obtaining completed interviews in the fourth follow-up survey and for collecting academic transcripts.

A. Fourth Follow-Up Survey of Students

The fourth follow-up survey was conducted between April 2001 and December 2002. It was designed to collect information on secondary and postsecondary educational outcomes approximately five to seven years after scheduled completion of high school.

1. Data Collection Modes

One week before we began interviewing, we sent a letter to all study participants. The letter indicated that we would call them to complete an interview for an important study, and it encouraged them to participate. In addition, the letter indicated that we would pay them $10 for completing the interview.

Most interviews were administered using computer-assisted telephone interviewing (CATI). CATI interviews took about 30 minutes to complete. When a CATI interview was not possible, we attempted to obtain a completed questionnaire through the mail. Study participants were also offered the option of completing the survey on the Web. In June 2001, questionnaires were mailed to study participants that could not be reached by telephone. Three additional follow up mailings were conducted after the first mailing, with the last set of questionnaires being sent out in January 2002.

2. Locating

Throughout the data collection period, locating staff used services such as LexisNexis and Internet databases to obtain updated addresses and phone numbers for study participants that were difficult to reach.

3. Incentives

Financial incentives for survey completion were used to obtain a high response rate. Study participants were offered a $10 incentive for participating in the survey. Incentive checks were mailed after the sample member completed the interview.

4. Response Rates

The eligible sample consisted of 1,759 UBMS participants and 2,830 sample members from the evaluation of regular Upward Bound. (See Chapter III for more details on the samples.) We obtained completed interviews for 1,425 UBMS participants and 2,146 regular Upward Bound sample members for response rates of 81 percent and 76 percent, respectively (see Table A.1).

B. Transcript Data Collection

Secondary and postsecondary transcripts were collected between July 2002 and March 2003. Academic transcripts provided the primary source of information on postsecondary achievement. Transcript requests were made from institutions that were reported by sample members in the fourth follow-up survey of students and in earlier surveys.

1. Preparation for Requesting Transcripts

Information about students' secondary and postsecondary enrollment was primarily obtained from follow-up interviews. Students reported the secondary and postsecondary institutions that they had attended. Secondary transcripts were only requested from UBMS sample members selected for the impact analysis; postsecondary transcripts were requested from all sample members—both UBMS and regular Upward Bound—who reported or confirmed having attended a particular postsecondary institution.[48]

To obtain mailing addresses for the schools that were attended by sample members, we matched schools that were reported by survey respondents to directories of secondary and postsecondary schools maintained by the U.S. Department of Education. Secondary schools were matched to the Common Core of Data (CCD); postsecondary schools were matched to the integrated Postsecondary Education Data System (IPEDS).[49]

[48] We did not collect secondary transcripts for regular Upward Bound sample members because we had already collected these transcripts for a large percentage of the sample in previous waves of data collection.

[49] Students were asked to provide the name and state of each secondary and postsecondary school they attended, but sometimes misspellings or incomplete information resulted in some invalid requests for student transcripts as schools were matched with an incorrect address and transcripts were requested from the wrong school. When a school indicated that they could not fill a request because they had no record of the student whose transcript we requested, it was sometimes due to such mismatches. In these cases, we attempted to learn the correct name and address of the school where the student was enrolled and make a new transcript request.

Table A.1

Fourth Follow-up Survey of Students

	UBMS Sample	Regular UB Sample	Full Sample
Completed Interview	1,425	2,146	3,571
Eligible Nonrespondent	334	684	1,018
Ineligible - Deceased	7	14	21
Total	1,766	2,844	4,610

2. Procedures for Requesting Transcripts

Each school was sent a transcript request packet that included:

- A letter, printed on Department of Education letterhead, which explained the purpose of the study and the reason we were requesting transcripts.
- A statement of Authorization and Confidentiality, which cited the *Family Educational Rights and Privacy Act* and included questions and answers regarding consent and confidentiality.
- A transcript checklist of all the materials that we requested from the school, including student transcripts, a course catalog, grade descriptions and a transcript reimbursement form, which would indicate the reimbursement that the school required for providing the requested transcripts.
- A postage-paid business reply envelope for sending the transcripts.
- A disclosure notice to be placed in each student's file, indicating that a copy of his or her transcript was released to Mathematica Policy Research as an agent to the U.S. Department of Education.

3. Follow-Up Procedures

For schools that did not respond to our initial request for transcripts, we mailed another request for student transcripts. These mailings were done periodically as we tracked the schools that had not yet sent the requested transcripts and corrected requests that contained errors.

As the targeted end date for collecting transcripts approached, interviewers started calling schools directly to inquire about the status of our requests. Many schools responded to these calls by faxing us the requested transcripts. When the school indicated that they could not provide one or more of the requested transcripts, the interviewer completed a problem sheet indicating the reason. The reason generally fell into one of the following categories:

- ***The student was never enrolled at the school according to the school's records.*** When this occurred, our first response was to call the school and provide more information on the student (e.g., provide or verify date of birth and dates of attendance) to see if a transcript could be located with additional information. In many cases, the school was able to locate and provide transcripts once additional information was provided. In other cases, the school provided some information that helped us determine where we might obtain the needed transcripts.[50] If the school had no record of the student having ever attended and we were unable to obtain additional information, we marked the case as an invalid request.

- ***Transcripts were held by the school district.*** Some schools only held the transcripts of currently enrolled students and all other transcripts were sent to the school district. in this situation, the school would sometimes forward the request packet to the district. Other times, the school returned the materials to us, and we sent them to the school district.

- ***The student transferred to another school.*** When the student had transferred to another school, a transcript was requested from the school to which the student had transferred. In some cases, the registrar or school secretary forwarded the request materials to the transfer school. in other cases, the request materials were sent back to us and we sent a new request to the transfer school.

- ***The school would not release any transcript without student's written consent.*** A few schools returned the transcript request materials with no transcripts, indicating that they required written consent from each student whose transcript we were requesting. A problem sheet was completed for these cases, and they were forwarded to the survey manager for follow-up. As a first step, the survey manager called the school to explain that, as an agent of the Department of Education, Mathematica Policy Research was authorized to collect student transcripts for the purposes of this study and that, according to the laws of *FERPA*, schools are permitted to release student transcripts to the Department of Education without the written consent of students participating in the study. It was also explained that students had given verbal consent over the telephone or written consent when they completed the mail survey, and that we did not request transcripts for any students who refused consent. Some schools agreed to send the requested transcripts upon hearing this explanation. Others reiterated that signed consent was required by school policy. in this case, we sent written consent forms to the students for them to sign and return to Mathematica so that we could obtain their student transcript for the impact study. A postage-paid return envelope was included with the consent form. A small number of students did sign and return the consent form, but most of the letters came back unopened because we no longer had a valid address for the student.

[50] For example, some school principals and registrars indicated that their school was often confused with another school having the same or a similar name and suggested that we direct our request to the other school. In this case, we would call the alternate school to find out if the student was ever enrolled there. If so, we made a correction to the database and sent a request to the newly identified school.

- ***The school would not release transcripts without advance payment.*** In these cases, we sent a check to cover the cost of each transcript, along with a list of the students whose transcripts we were requesting.

- ***The school would not release a transcript until the student paid an outstanding debt.*** In some cases we were eventually able to obtain these transcripts as students paid whatever bills they owed the school. When the debt remained unpaid, however, there was no way we could get the transcript. These cases were marked as unfilled requests.

4. Response Rates

From the samples used in the impact analysis described in Chapter III, 1,365 students reported having attended at least one postsecondary institution that could be matched to IPEDS. for each of these 1,365 students, we requested a transcript from each of the postsecondary institutions that he or she reported attending. In total, we requested 2,029 transcripts. We received 1,821 of the 2,029 transcripts requested (90 percent), and we obtained a complete transcript record—that is, transcripts for all postsecondary institutions attended—for 1,109 students (see Table A.2).

Table A.2

Postsecondary Transcript Data Collection for the Upward Bound Math-Science Impact Analysis

Postsecondary Students	UBMS Sample	Regular UB Sample	Full Sample
Complete Transcript Record	472	637	1,109
Incomplete Transcript Record	101	155	256
Total Postsecondary Students	573	792	1,365

APPENDIX B

PROGRAM IMPACTS

Table B.1

Impact of Upward Bound Math Science on High School Outcomes

	UBMS Participants	Comparison Group	Impact
Overall			
Total Credits	25.7	24.5	1.2 ***
Grade Point Average (GPA)	3.1	3.1	0.1 ***
Math Courses Taken			
Algebra (%)	97	97	0 !
Geometry (%)	86	86	0
Algebra II (%)	73	74	-1
Trigonometry (%)	35	30	5
Analysis / Precalculus (%)	36	31	5
Calculus (%)	26	24	2
Advanced Placement Calculus (%)	6	10	-3 *
GPA in Algebra or above	2.8	2.7	0.1 ***
Science Courses Taken			
Biology (%)	97	98	-1
Chemistry (%)	88	78	10 ***
Physics (%)	58	43	15 ***
Advanced Placement Biology, Chemistry, or Physics (%)	4	9	-5 !
GPA in Biology, Chemistry, and Physics	2.9	2.7	0.2 ***
High School Status (%)			
Graduated	99	96	2 ***
Dropped out	1	2	-2 !
General Educational Development (GED)	0	1	-1 !

Source: MPR analysis file "UBMSImpact6.sas."

*/**/*** Impact estimate is statistically significant at the 0.10 / 0.05 / 0.01 level.

! Statistical significance could not be assessed due to complete or semi-complete separation.

Note 1: All estimates are weighted to account for missing data.

Note 2: The comparison group estimates and impact estimates are regression-adjusted (see Chapter III, Section A.4).

Table B.2

Impact of Upward Bound Math Science on High School Outcomes by Prior Participation in Regular Upward Bound

	Participated in Regular Upward Bound			Did Not Participate in Regular Upward Bound			
	UBMS Participants	Comparison Group	Impact	UBMS Participants	Comparison Group	Impact	
Overall							
Total Credits	24.6	24.5	0.1	26.0	24.5	1.5 ***	#
Grade Point Average (GPA)	3.1	3.0	0.0	3.2	3.1	0.1 ***	
Math Courses Taken							
Algebra (%)	97	98	-1 !	97	97	1 !	
Geometry (%)	88	88	0	86	85	1	
Algebra II (%)	66	78	-12 **	74	73	1	#
Trigonometry (%)	38	27	11 **	34	30	4	
Analysis / Precalculus (%)	34	29	5	37	32	5	
Calculus (%)	22	21	2	27	25	2	
Advanced Placement Calculus (%)	6	7	-2	7	10	-3 *	
GPA in Algebra or above	2.7	2.6	0.1	2.8	2.7	0.1 ***	
Science Courses Taken							
Biology (%)	98	97	1 !	97	98	-1	
Chemistry (%)	91	78	13 ***	88	79	9 ***	
Physics (%)	53	41	12 **	59	43	16 ***	
Advanced Placement Biology, Chemistry, or Physics (%)	2	5	-4 !	5	10	-5 **	
GPA in Biology, Chemistry, and Physics	2.8	2.7	0.1 **	2.9	2.7	0.2 ***	
High School Status (%)							
Graduated	100	99	1 !	99	96	3 **	
Dropped out	0	1	-1 !	1	3	-2 !	
General Educational Development (GED)	0	0	0 !	1	1	-1 !	

Source: MPR analysis file "UBMSImpact6.sas."

*/**/*** Impact estimate is statistically significant at the 0.10 / 0.05 / 0.01 level.

Impact estimate is significantly different from the impact on students who participated in regular Upward Bound at the 0.10 level.

! Statistical significance could not be assessed due to complete or semi-complete separation.

Note 1: All estimates are weighted to account for missing data.

Note 2: The comparison group estimates and impact estimates are regression-adjusted (see Chapter III, Section A.4).

Table B.3

Impact of Upward Bound Math Science on High School Outcomes by Sex

	Male			Female			
	UBMS Participants	Comparison Group	Impact	UBMS Participants	Comparison Group	Impact	
Overall							
Total Credits	25.3	24.6	0.7	26.1	24.5	1.6 ***	
Grade Point Average (GPA)	3.1	3.0	0.1 *	3.2	3.1	0.1 ***	
Math Courses Taken							
Algebra (%)	97	98	0 !	97	97	0 !	
Geometry (%)	84	87	-3	88	84	3	#
Algebra II (%)	77	73	4	70	74	-5	
Trigonometry (%)	33	34	-1	36	28	8 *	
Analysis / Precalculus (%)	42	35	7	32	28	4	
Calculus (%)	25	22	3	27	25	2	
Advanced Placement Calculus (%)	7	9	-2	6	10	-4	
GPA in Algebra or above	2.7	2.6	0.1	2.8	2.7	0.1 ***	
Science Courses Taken							
Biology (%)	98	99	-1 !	97	98	-1	
Chemistry (%)	87	77	11 ***	89	80	9 ***	
Physics (%)	60	48	12 **	56	39	18 ***	
Advanced Placement Biology, Chemistry, or Physics (%)	5	7	-2 !	4	10	-6 !	
GPA in Biology, Chemistry, and Physics	2.9	2.6	0.3 ***	2.9	2.8	0.2 ***	
High School Status (%)							
Graduated	98	98	0 !	99	96	4 !	
Dropped out	1	1	0 !	0	2	-2 !	
General Educational Development (GED)	1	1	0 !	0	2	-1 !	

Source: MPR analysis file "UBMSImpact6.sas."

*/**/*** Impact estimate is statistically significant at the 0.10 / 0.05 / 0.01 level.

Impact estimate is significantly different from the impact on males at the 0.10 level.

! Statistical significance could not be assessed due to complete or semi-complete separation.

Note 1: All estimates are weighted to account for missing data.

Note 2: The comparison group estimates and impact estimates are regression-adjusted (see Chapter III, Section A.4).

Table B.4

Impact of Upward Bound Math Science on High School Outcomes by Race and Ethnicity

	African American			White			Hispanic		
	UBMS Participants	Comparison Group	Impact	UBMS Participants	Comparison Group	Impact	UBMS Participants	Comparison Group	Impact
Overall									
Total Credits	25.5	24.1	1.4 **	26.0	25.2	0.8	26.4	24.6	1.9 **
Grade Point Average (GPA)	2.9	2.9	0.1 *	3.3	3.3	0.0	3.2	3.0	0.2 *** #
Math Courses Taken									
Algebra (%)	96	97	-1 !	100	99	1 !	96	95	0 !
Geometry (%)	88	89	-1	91	87	5 **	81	79	2
Algebra II (%)	75	75	0	79	81	-2 !	67	74	-7
Trigonometry (%)	35	32	2	38	31	7	35	24	11 *
Analysis / Precalculus (%)	33	27	5	30	22	8	42	30	12
Calculus (%)	17	16	1	27	27	1	29	21	9 !
Advanced Placement Calculus (%)	4	4	0 !	4	12	-8 !	9	8	1 !
GPA in Algebra or above	2.5	2.4	0.1	3.2	3.1	0.1	2.7	2.4	0.3 *** #
Science Courses Taken									
Biology (%)	97	99	-2	98	98	0 !	98	96	2 !
Chemistry (%)	90	83	7 **	87	77	10 !	87	70	17 *** #
Physics (%)	53	46	7	59	36	22 *** #	59	32	27 *** #
Advanced Placement Biology, Chemistry, or Physics (%)	4	7	-3 !	2	6	-4 !	6	12	-6 !
GPA in Biology, Chemistry, and Physics	2.7	2.5	0.2 ***	3.3	3.0	0.3 ***	2.9	2.7	0.2 **
High School Status (%)									
Graduated	100	97	3 !	99	97	2 !	98	96	3 !
Dropped out	0	2	-2 !	0	2	-2 !	2	4	-3 !
General Educational Development (GED)	0	0	0 !	1	1	0 !	0	2	-2 !

Source: MPR analysis file "UBMSImpact6.sas."

*/**/*** Impact estimate is statistically significant at the 0.10 / 0.05 / 0.01 level.

Impact estimate is significantly different from the impact on African Americans at the 0.10 level.

! Statistical significance could not be assessed due to complete or semi-complete separation.

Note 1: All estimates are weighted to account for missing data.

Note 2: The comparison group estimates and impact estimates are regression-adjusted (see Chapter III, Section A.4).

Table B.5

Impact of Upward Bound Math Science on Postsecondary Outcomes

	UBMS Participants	Comparison Group	Impact
Postsecondary Enrollment (%)			
Any postsecondary institution	95	90	5 ***
Highest level of schooling attended			
Four-year college or university	82	71	11 ***
Two-year college	11	16	-5 **
Vocational institution	2	4	-2
College Selectivity (%)			
Most selective four-year college or university			
More selective	33	23	11 ***
Less selective	48	48	0
Postsecondary Credits Earned (mean)			
Two- and four-year colleges and universities	98.1	85.0	13.1 ***
Four-year colleges and universities	86.6	73.1	13.5 **
Two-year colleges and universities	11.5	11.9	-0.5
Postsecondary Completion (%)			
Any degree, certificate, or license	47	46	1
Highest degree, certificate, or license earned			
Bachelor's degree or higher	35	33	2
Associate's degree	7	7	-1
Certificate or license	5	5	-1

Source: MPR analysis file "UBMSImpact6.sas."

*/**/*** Impact estimate is statistically significant at the 0.10 / 0.05 / 0.01 level.

! Statistical significance could not be assessed due to complete or semi-complete separation.

Note 1: All estimates are weighted to account for missing data.

Note 2: The comparison group estimates and impact estimates are regression-adjusted (see Chapter III, Section A.4).

Table B.6

Impact of Upward Bound Math Science on Postsecondary Outcomes by Prior Participation in Regular Upward Bound

	Participated in Regular Upward Bound			Did Not Participate in Regular Upward Bound		
	UBMS Participants	Comparison Group	Impact	UBMS Participants	Comparison Group	Impact
Postsecondary Enrollment (%)						
Any postsecondary institution	99	91	8 ***	95	90	5 ***
Highest level of schooling attended						
Four-year college or university	81	71	10 *	82	70	12 ***
Two-year college	18	16	1	10	16	-6 **
Vocational institution	0	4	-4 !	3	4	-1
College Selectivity (%)						
Most selective four-year college or university						
More selective	35	24	11 **	33	22	11 ***
Less selective	46	47	-1	48	48	0
Postsecondary Credits Earned (mean)						
Two- and four-year colleges and universities	103.4	84.2	19.2 **	96.9	85.2	11.7 **
Four-year colleges and universities	90.1	69.2	20.9 **	85.9	74.3	11.5 *
Two-year colleges and universities	13.3	15.0	-1.7	11.1	10.9	0.2
Postsecondary Completion (%)						
Any degree, certificate, or license	42	43	-2	48	46	2
Highest degree, certificate, or license earned						
Bachelor's degree or higher	31	29	2	36	34	2
Associate's degree	7	5	2	7	8	-1
Certificate or license	4	8	-4	5	5	0

Source: MPR analysis file "UBMSImpact6.sas."

*/**/*** Impact estimate is statistically significant at the 0.10 / 0.05 / 0.01 level.

Impact estimate is significantly different from the impact on students who participated in regular Upward Bound at the 0.10 level.

! Statistical significance could not be assessed due to complete or semi-complete separation.

Note 1: All estimates are weighted to account for missing data.

Note 2: The comparison group estimates and impact estimates are regression-adjusted (see Chapter III, Section A.4).

Table B.7

Impact of Upward Bound Math Science on Postsecondary Outcomes by Sex

	Male			Female			
	UBMS Participants	Comparison Group	Impact	UBMS Participants	Comparison Group	Impact	
Postsecondary Enrollment (%)							
Any postsecondary institution	96	89	7 ***	95	90	5 ***	
Highest level of schooling attended							
Four-year college or university	82	76	6	82	68	14 ***	#
Two-year college	12	12	0	10	18	-8 ***	#
Vocational institution	2	2	0	2	4	-2	
College Selectivity (%)							
Most selective four-year college or university							
More selective	34	23	11 **	32	21	11 ***	
Less selective	48	52	-5	48	46	2	
Postsecondary Credits Earned (mean)							
Two- and four-year colleges and universities	96.6	85.7	10.9	99.1	85.2	13.9 ***	
Four-year colleges and universities	83.2	73.5	9.7	88.9	72.7	16.2 ***	
Two-year colleges and universities	13.4	12.2	1.2	10.1	12.5	-2.3	
Postsecondary Completion (%)							
Any degree, certificate, or license	40	43	-3	51	46	6	
Highest degree, certificate, or license earned							
Bachelor's degree or higher	27	33	-6	40	32	9 **	#
Associate's degree	8	4	4 *	6	10	-4 *	#
Certificate or license	5	5	0	5	5	0	

Source: MPR analysis file "UBMSImpact6.sas."

*/**/*** Impact estimate is statistically significant at the 0.10 / 0.05 / 0.01 level.

Impact estimate is significantly different from the impact on males at the 0.10 level.

! Statistical significance could not be assessed due to complete or semi-complete separation.

Note 1: All estimates are weighted to account for missing data.

Note 2: The comparison group estimates and impact estimates are regression-adjusted (see Chapter III, Section A.4).

Table B.8

Impact of Upward Bound Math Science on Postsecondary Outcomes by Race and Ethnicity

	African American			White			Hispanic		
	UBMS Participants	Comparison Group	Impact	UBMS Participants	Comparison Group	Impact	UBMS Participants	Comparison Group	Impact
Postsecondary Enrollment (%)									
Any postsecondary institution	97	93	5 !	95	87	8 !	95	92	2 !
Highest level of schooling attended									
Four-year college or university	87	74	13 ***	79	67	12 !	80	72	8 !
Two-year college	9	15	-6	12	19	-7 !	14	17	-3 !
Vocational institution	1	3	-2 !	5	1	4 !	0	6	-6 !
College Selectivity (%)									
Most selective four-year college or university									
More selective	29	19	10 **	24	11	13 ***	38	36	3
Less selective	57	54	3	54	55	0	42	35	7
Postsecondary Credits Earned (mean)									
Two- and four-year colleges and universities	105.9	87.0	18.9 **	92.9	85.8	7.2	97.6	65.7	31.9 ***
Four-year colleges and universities	99.4	79.2	20.2 **	81.6	73.3	8.4	81.2	52.9	28.3 ***
Two-year colleges and universities	6.5	7.8	-1.3	11.3	12.5	-1.2	16.4	12.8	3.6
Postsecondary Completion (%)									
Any degree, certificate, or license	49	46	3	46	35	10 **	49	49	-1
Highest degree, certificate, or license earned									
Bachelor's degree or higher	38	36	1	36	19	17 *** #	33	30	3
Associate's degree	5	4	2 !	8	10	-3	8	13	-5
Certificate or license	6	6	-1 !	2	6	-4 !	8	5	3

Source: MPR analysis file "UBMSImpact6.sas."

*/**/*** Impact estimate is statistically significant at the 0.10 / 0.05 / 0.01 level.

Impact estimate is significantly different from the impact on African Americans at the 0.10 level.

! Statistical significance could not be assessed due to complete or semi-complete separation.

Note 1: All estimates are weighted to account for missing data.

Note 2: The comparison group estimates and impact estimates are regression-adjusted (see Chapter III, Section A.4).

Table B.9

Impact of Upward Bound Math Science on Postsecondary Field of Study

Field of Study	UBMS Participants	Comparison Group	Impact
Field of Study at Most Recent PS Institution (%)			
All postsecondary institutions			
Math and science fields	33	23	10 ***
Social science fields	11	7	4 *
Other fields	42	51	-9 ***
Four-year colleges and universities			
Math and science fields	28	18	10 ***
Social science fields	10	7	4 *
Other fields	36	39	-3
Earned Degree or Certificate in Field (%)			
All postsecondary institutions			
Math and science fields	15	12	3
Social science fields	7	4	3
Other fields	21	28	-7 **
Four-year colleges and universities			
Math and science fields	12	6	6 ***
Social science fields	6	4	3
Other fields	14	20	-6 **

Source: MPR analysis file "UBMSImpact6.sas."

*/**/*** Impact estimate is statistically significant at the 0.10 / 0.05 / 0.01 level.

! Statistical significance could not be assessed due to complete or semi-complete separation.

Note 1: All estimates are weighted to account for missing data.

Note 2: The comparison group estimates and impact estimates are regression-adjusted (see Chapter III, Section A.4).

Table B.10

Impact of Upward Bound Math Science on Postsecondary Field of Study by Prior Participation in Regular Upward Bound

Field of Study	Participated in Regular Upward Bound			Did Not Participate in Regular Upward Bound			
	UBMS Participants	Comparison Group	Impact	UBMS Participants	Comparison Group	Impact	
Field of Study at Most Recent PS Institution (%)							
All postsecondary institutions							
Math and science fields	35	26	10 *	32	22	10 **	
Social science fields	13	7	6 *	11	8	3	
Other fields	38	47	-9	43	52	-9 **	
Four-year colleges and universities							
Math and science fields	29	23	6	28	17	12 ***	
Social science fields	12	6	6	10	7	3	
Other fields	31	35	-3	37	40	-4	
Earned Degree or Certificate in Field (%)							
All postsecondary institutions							
Math and science fields	13	12	1	15	11	4	
Social science fields	6	3	3	7	4	3	
Other fields	20	24	-4	22	29	-7 **	
Four-year colleges and universities							
Math and science fields	8	10	-2 !	13	5	8 ***	
Social science fields	4	3	1	7	4	3	
Other fields	15	13	2	14	22	-8 **	#

Source: UBMSImpact6.sas

*/**/*** Impact estimate is statistically significant at the 0.10 / 0.05 / 0.01 level.

Impact estimate is significantly different from the impact on students who participated in regular Upward Bound at the 0.10 level.

! Statistical significance could not be assessed due to complete or semi-complete separation.

Note 1: All estimates are weighted to account for missing data.

Note 2: The comparison group estimates and impact estimates are regression-adjusted (see Chapter III, Section A.4).

Table B.11

Impact of Upward Bound Math Science on Postsecondary Field of Study by Sex

Field of Study	Male			Female			
	UBMS Participants	Comparison Group	Impact	UBMS Participants	Comparison Group	Impact	
Field of Study at Most Recent PS Institution (%)							
All postsecondary institutions							
Math and science fields	44	28	16 ***	24	19	5	
Social science fields	9	5	4	12	9	3	
Other fields	31	46	-15 ***	50	53	-3	#
Four-year colleges and universities							
Math and science fields	38	25	13 **	22	13	9 **	
Social science fields	8	4	5 *	12	9	3	
Other fields	27	38	-12 **	42	39	4	#
Earned Degree or Certificate in Field (%)							
All postsecondary institutions							
Math and science fields	16	10	6 *	14	11	3	
Social science fields	5	3	2 !	8	5	3 *	
Other fields	15	25	-10 **	26	28	-2	
Four-year colleges and universities							
Math and science fields	11	6	5 *	13	5	8 ***	
Social science fields	4	3	1 !	8	4	4 **	
Other fields	9	19	-11 ***	18	20	-2	#

Source: MPR analysis file "UBMSImpact6.sas."

*/**/*** Impact estimate is statistically significant at the 0.10 / 0.05 / 0.01 level.

Impact estimate is significantly different from the impact on males at the 0.10 level.

! Statistical significance could not be assessed due to complete or semi-complete separation.

Note 1: All estimates are weighted to account for missing data.

Note 2: The comparison group estimates and impact estimates are regression-adjusted (see Chapter III, Section A.4).

Table B.12

Impact of Upward Bound Math Science on Postsecondary Field of Study by Race and Ethnicity

Field of Study	African American			White				Hispanic		
	UBMS Participants	Comparison Group	Impact	UBMS Participants	Comparison Group	Impact		UBMS Participants	Comparison Group	Impact
Field of Study at Most Recent PS Institution (%)										
All postsecondary institutions										
Math and science fields	32	25	7	34	26	8		28	14	15 **
Social science fields	13	6	6 **	9	4	5 !		12	8	4 !
Other fields	42	59	-17 ***	42	50	-8		48	55	-7
Four-year colleges and universities										
Math and science fields	30	20	10 *	27	20	7		26	8	18 **
Social science fields	13	6	7 **	8	4	4 !		8	7	1 !
Other fields	38	44	-7	35	38	-4		40	45	-5
Earned Degree or Certificate in Field (%)										
All postsecondary institutions										
Math and science fields	14	10	4 !	16	9	6		15	9	7
Social science fields	8	4	4 *	5	2	4 !		5	5	0 !
Other fields	21	32	-11 **	21	20	1	#	26	30	-4
Four-year colleges and universities										
Math and science fields	13	6	7 !	13	5	8 !		11	2	9 !
Social science fields	7	3	4 *	5	2	4 !		5	5	0 !
Other fields	15	23	-8 *	13	9	4	#	15	19	-4

Source: MPR analysis file "UBMSImpact6.sas."

*/**/*** Impact estimate is statistically significant at the 0.10 / 0.05 / 0.01 level.

Impact estimate is significantly different from the impact on African Americans at the 0.10 level.

! Statistical significance could not be assessed due to complete or semi-complete separation.

Note 1: All estimates are weighted to account for missing data.

Note 2: The comparison group estimates and impact estimates are regression-adjusted (see Chapter III, Section A.4).

APPENDIX C

SENSITIVITY OF IMPACTS TO AN ALTERNATIVE MEASURE OF POSTSECONDARY ATTENDANCE

A. Verification of Students' Postsecondary Attendance

In Chapter III, we presented estimates of the effects of UBMS on postsecondary attendance based on self-reported attendance—specifically, the schools that sample members reported attending after high school. However, in some instances, sample members may not have actually attended the schools they reported. For example, some may have reported schools that they planned to attend but never attended, and others may have reported schools at which they participated in a noncredit program but were not enrolled as students. In this appendix, we conduct an analysis to determine if the impact estimates presented in Chapter III are sensitive to an alternative measure of postsecondary attendance, one that requires verification by the postsecondary institution that students reported attending.

Myers et al. (2004) present the results of this analysis in the text of the report along with the analysis based on self-reported data, which effectively provided two impact estimates for each outcome. When one of the two impact estimates was statistically insignificant, the results were characterized as inconclusive because at that time, we were unable to persuade ourselves that one method was more reliable than the other. However, we have since conducted an investigation of the verification process, and the results of this analysis indicate that on average, the self-reported measures of postsecondary attendance are more accurate than the measures requiring verification by the institution. While this may seem counterintuitive, in constructing postsecondary attendance measures that required verification, we assumed that students did not attend the schools they reported unless attendance was verified by the school, typically through the provision of a transcript. However, the transcript collection process was not originally designed to verify attendance.[51] And in most instances when a school was unable or unwilling to provide a transcript, a careful examination of the data suggests that the student probably did attend the school—or at the very least, the school gave us no reason to doubt the student had attended when explaining why they would not provide a transcript.

The verification process worked as follows. In the third and fourth follow-up surveys, students reported all postsecondary institutions that they had attended since high school. We then attempted to match all reported schools to the 1997-98 Integrated Postsecondary Education Data System (IPEDS) maintained by the National Center for Education Statistics (NCES) to determine whether they met NCES's definition of a postsecondary institution and to obtain school contact information. Transcript requests were then sent to all schools a student reported attending that we were able to match to IPEDS and schools that did not initially respond were followed up. If a school provided a transcript that we requested for a student in the sample, then the student clearly attended that school. Furthermore, some of the reasons given by school staff for not providing transcripts can be treated as verification of attendance, for example, a college indicating that it could not provide a transcript for a student because he or she owed money to the school. In many instances, however, the reason given for not providing transcripts does not clearly indicate whether the student attended the school. For example, some schools required written consent from the students themselves even though the law does not require it, and we typically obtained only oral consent (see Appendix B); in these cases, lack of verification casts no doubt on the student's self-reported attendance.

[51] For the final report of this evaluation, which will use postsecondary transcript data collected in 2004-05, the transcript data collection process has been modified to specifically verify attendance if possible.

The information obtained while collecting transcripts is therefore useful in verifying attendance in some but not all cases. In the vast majority of cases considered (approximately 80 percent) we were able to verify the student's attendance. However, for approximately 220 students, the fact that we were unable to verify attendance for at least one of their reported postsecondary institutions changed at least one outcome of interest.[52] In investigating these cases, we found little evidence that contradicted a student's report of their postsecondary schools attended. One concern was that some Upward Bound participants would report the school at which they attended an Upward Bound summer bridge program but did not actually enroll; we found no evidence that this happened.[53] Similarly, there was little evidence that many students reported attending institutions that are not classified by IPEDS as postsecondary institutions, and, in fact, non-IPEDS institutions such as Job Corps programs were excluded through the IPEDS match. The lack of verification more often appeared to be due to schools that would not release transcripts without written consent, ambiguities in the exact campus attended by the student within a large state system, or insufficient information about the school reported by the student to know which school to contact for transcript information. More often than not, lack of verification seemed to mainly reflect limitations of the verification process rather than inaccuracies in the information provided by students.

B. Differences in Impacts

This section presents estimates of the impacts of Upward Bound that use information only on schools that we were able to verify the student attended. These estimates make the strong assumption that lack of verification of attendance implies that the student did not attend the school in question or any school like it.

Because most attendance reported by students was verified through transcript receipt, most of the impacts presented here are very similar to those estimated using information on all schools that students reported attending. There are a few differences between the estimates presented here and the estimates presented in Chapter III, but there is probably only one worth noting: the finding that UBMS has a positive effect on the likelihood of attending some type of postsecondary institution is sensitive to the verification process. If we require verification of postsecondary attendance, the estimated effect becomes statistically insignificant (compare Table C.1 to Table B.5). For the full set of estimates from the sensitivity analysis, see Tables C.1 - C.4.

[52] There may be cases in which we were not able to verify a student's attendance at all schools but for which that did not affect the outcome variables of interest. For example, if we verified a student's attendance at a four-year college or university but could not verify his or her attendance at a vocational school they reported attending, he or she will still be classified as having their highest level of schooling as a four-year college or university.

[53] Students participate in Upward Bound summer bridge programs the summer before enrolling in college. Because the survey question simply asks students to list all postsecondary institutions attended since high school graduation, there was concern that some students may list the school at which they participated in a summer bridge program.

Table C.1

Impact of Upward Bound Math Science on Postsecondary Outcomes,
Excludes Unverified Enrollment and Completion

	UBMS Participants	Comparison Group	Impact
Postsecondary Enrollment (%)			
Any postsecondary institution	89	87	2
Highest level of schooling attended			
Four-year college or university	77	68	9 ***
Two-year college	11	16	-5 **
Vocational institution	1	3	-2 *
College Selectivity (%)			
Most selective four-year college or university			
More selective	30	21	9 ***
Less selective	46	47	-1
Postsecondary Credits Earned (mean)			
Two- and four-year colleges and universities	84.8	75.2	9.6 **
Four-year colleges and universities	75.3	64.8	10.5 **
Two-year colleges and universities	9.6	10.4	-0.8
Postsecondary Completion (%)			
Any degree, certificate, or license	43	43	0
Highest degree, certificate, or license earned			
Bachelor's degree or higher	33	32	1
Associate's degree	6	7	-1
Certificate or license	4	4	1

Source: MPR analysis file "UBMSImpact6.sas."

*/**/*** Impact estimate is statistically significant at the 0.10 / 0.05 / 0.01 level.

! Statistical significance could not be assessed due to complete or semi-complete separation.

Note 1: All estimates are weighted to account for missing data.

Note 2: The comparison group estimates and impact estimates are regression-adjusted (see Chapter III, Section A.4).

Table C.2

Impact of Upward Bound Math Science on Postsecondary Outcomes by Prior Participation in Regular Upward Bound, Excludes Unverified Enrollment and Completion

	Participated in Regular Upward Bound			Did Not Participate in Regular Upward Bound		
	UBMS Participants	Comparison Group	Impact	UBMS Participants	Comparison Group	Impact
Postsecondary Enrollment (%)						
Any postsecondary institution	91	86	4	89	87	2
Highest level of schooling attended						
Four-year college or university	75	67	8	77	68	9 ***
Two-year college	16	17	0	10	16	-6 **
Vocational institution	0	2	-2 !	1	3	-2
College Selectivity (%)						
Most selective four-year college or university						
More selective	31	23	8	30	20	10 ***
Less selective	44	43	0	46	47	-1
Postsecondary Credits Earned (mean)						
Two- and four-year colleges and universities	83.5	65.7	17.8 ***	85.1	77.1	8.1
Four-year colleges and universities	72.8	53.9	18.9 **	75.8	67.0	8.8
Two-year colleges and universities	10.7	11.7	-1.1	9.3	10.1	-0.7
Postsecondary Completion (%)						
Any degree, certificate, or license	36	41	-6	45	43	2
Highest degree, certificate, or license earned						
Bachelor's degree or higher	25	28	-2	35	33	2
Associate's degree	6	5	1	6	7	-1
Certificate or license	4	7	-2	4	3	1

Source: MPR analysis file "UBMSImpact6.sas."

*/**/*** Impact estimate is statistically significant at the 0.10 / 0.05 / 0.01 level.

Impact estimate is significantly different from the impact on students who participated in regular Upward Bound at the 0.10 level.

! Statistical significance could not be assessed due to complete or semi-complete separation.

Note 1: All estimates are weighted to account for missing data.

Note 2: The comparison group estimates and impact estimates are regression-adjusted (see Chapter III, Section A.4).

Table C.3

Impact of Upward Bound Math Science on Postsecondary Outcomes by Sex,
Excludes Unverified Enrollment and Completion

	Male			Female			
	UBMS Participants	Comparison Group	Impact	UBMS Participants	Comparison Group	Impact	
Postsecondary Enrollment (%)							
Any postsecondary institution	88	88	1	89	85	4 *	
Highest level of schooling attended							
Four-year college or university	74	74	0	78	64	15 ***	#
Two-year college	13	13	0	10	18	-8 ***	#
Vocational institution	1	1	0 !	1	4	-3 *	
College Selectivity (%)							
Most selective four-year college or university							
More selective	30	21	9 **	30	19	10 ***	
Less selective	43	53	-9 *	47	44	3	#
Postsecondary Credits Earned (mean)							
Two- and four-year colleges and universities	80.2	76.3	3.9	88.1	73.9	14.2 ***	
Four-year colleges and universities	69.7	67.6	2.0	79.2	62.0	17.3 ***	#
Two-year colleges and universities	10.6	8.7	1.9	8.9	11.9	-3.1	
Postsecondary Completion (%)							
Any degree, certificate, or license	37	42	-5	48	43	6	#
Highest degree, certificate, or license earned							
Bachelor's degree or higher	26	33	-7	38	31	7 *	#
Associate's degree	7	3	4 *	6	10	-4 *	#
Certificate or license	4	4	0	4	3	1	

Source: MPR analysis file "UBMSImpact6.sas."

*/**/*** Impact estimate is statistically significant at the 0.10 / 0.05 / 0.01 level.

Impact estimate is significantly different from the impact on males at the 0.10 level.

! Statistical significance could not be assessed due to complete or semi-complete separation.

Note 1: All estimates are weighted to account for missing data.

Note 2: The comparison group estimates and impact estimates are regression-adjusted (see Chapter III, Section A.4).

Table C.4

Impact of Upward Bound Math Science on Postsecondary Outcomes by Race and Ethnicity,
Excludes Unverified Enrollment and Completion

	African American			White			Hispanic		
	UBMS Participants	Comparison Group	Impact	UBMS Participants	Comparison Group	Impact	UBMS Participants	Comparison Group	Impact
Postsecondary Enrollment (%)									
Any postsecondary institution	91	89	1 !	89	86	4 !	87	83	4 !
Highest level of schooling attended									
Four-year college or university	82	72	11 **	74	67	7 !	72	62	10 !
Two-year college	8	16	-8 **	14	19	-5 !	16	19	-3 !
Vocational institution	1	3	-2 !	2	1	1 !	0	5	-5 !
College Selectivity (%)									
Most selective four-year college or university									
More selective	26	17	9 **	23	11	12 ***	34	25	9
Less selective	55	54	1	50	54	-5	38	34	4
Postsecondary Credits Earned (mean)									
Two- and four-year colleges and universities	88.5	73.8	14.8 **	86.2	77.2	9.0	82.4	52.6	29.8 ***
Four-year colleges and universities	83.3	66.7	16.7 **	75.9	65.7	10.2	67.9	41.3	26.6 ***
Two-year colleges and universities	5.2	7.1	-1.9	10.3	11.4	-1.2	14.5	11.4	3.2
Postsecondary Completion (%)									
Any degree, certificate, or license	44	41	3	43	35	9 *	46	43	3
Highest degree, certificate, or license earned									
Bachelor's degree or higher	35	36	-1	35	19	16 *** #	32	25	6
Associate's degree	4	4	1 !	8	10	-2	7	13	-6
Certificate or license	5	2	3 !	1	6	-5 !	8	3	4

Source: MPR analysis file "UBMSImpact6.sas."

*/**/*** Impact estimate is statistically significant at the 0.10 / 0.05 / 0.01 level.

Impact estimate is significantly different from the impact on African Americans at the 0.10 level.

! Statistical significance could not be assessed due to complete or semi-complete separation.

Note 1: All estimates are weighted to account for missing data.

Note 2: The comparison group estimates and impact estimates are regression-adjusted (see Chapter III, Section A.4).

APPENDIX D

SAMPLE SIZES AND STANDARD ERRORS

Table D.1

Sample Sizes and Standard Errors for Reported Impact Estimates: Table B.1

	Sample Size	Standard Error
Overall		
Total Credits	1,677	0.40
Grade Point Average (GPA)	1,677	0.02
Math Courses Taken		
Algebra (%)	1,677	0.70
Geometry (%)	1,677	2.35
Algebra II (%)	1,677	3.80
Trigonometry (%)	1,677	4.16
Analysis / Precalculus (%)	1,677	4.53
Calculus (%)	1,677	2.77
Advanced Placement Calculus (%)	1,677	1.43
GPA in Algebra or above	1,677	0.05
Science Courses Taken		
Biology (%)	1,677	0.91
Chemistry (%)	1,677	1.61
Physics (%)	1,677	3.07
Advanced Placement Biology, Chemistry, or Physics (%)	1,677	1.38
GPA in Biology, Chemistry, and Physics	1,677	0.04
High School Status (%)		
Graduated	1,677	0.51
Dropped out	1,677	0.37
General Educational Development (GED)	1,677	0.38

Source: MPR analysis file "UBMSImpact6.sas."
Note: Standard errors account for project clustering and were estimated using Taylor series linearization methods.

Table D.2

Sample Sizes and Standard Errors for Reported Impact Estimates: Table B.2

	Participated in Regular Upward		Did Not Participate in Regular	
	Sample Size	Standard Error	Sample Size	Standard Error
Overall				
Total Credits	640	0.52	1,037	0.43
Grade Point Average (GPA)	640	0.03	1,037	0.03
Math Courses Taken				
Algebra (%)	640	1.10	1,037	0.63
Geometry (%)	640	2.84	1,037	2.57
Algebra II (%)	640	5.85	1,037	3.66
Trigonometry (%)	640	6.08	1,037	4.59
Analysis / Precalculus (%)	640	5.55	1,037	4.91
Calculus (%)	640	4.21	1,037	3.17
Advanced Placement Calculus (%)	640	2.55	1,037	1.69
GPA in Algebra or above	640	0.08	1,037	0.05
Science Courses Taken				
Biology (%)	640	1.05	1,037	1.05
Chemistry (%)	640	2.44	1,037	1.88
Physics (%)	640	5.27	1,037	3.43
Advanced Placement Biology, Chemistry, or Physics (%)	640	1.44	1,037	1.66
GPA in Biology, Chemistry, and Physics	640	0.06	1,037	0.05
High School Status (%)				
Graduated	640	0.00	1,037	0.64
Dropped out	640	0.00	1,037	0.47
General Educational Development (GED)	640	0.00	1,037	0.49

Source: MPR analysis file "UBMSImpact6.sas."

Note: Standard errors account for project clustering and were estimated using Taylor series linearization methods.

Table D.3

Sample Sizes and Standard Errors for Reported Impact Estimates: Table B.3

	Male		Female	
	Sample Size	Standard Error	Sample Size	Standard Error
Overall				
Total Credits	578	0.47	1,098	0.47
Grade Point Average (GPA)	578	0.04	1,098	0.03
Math Courses Taken				
Algebra (%)	578	1.05	1,098	0.77
Geometry (%)	578	2.91	1,098	2.49
Algebra II (%)	578	4.40	1,098	4.43
Trigonometry (%)	578	5.84	1,098	4.64
Analysis / Precalculus (%)	578	4.87	1,098	5.10
Calculus (%)	578	4.47	1,098	3.29
Advanced Placement Calculus (%)	578	2.62	1,098	1.90
GPA in Algebra or above	578	0.08	1,098	0.05
Science Courses Taken				
Biology (%)	578	1.04	1,098	1.14
Chemistry (%)	578	2.62	1,098	1.88
Physics (%)	578	5.19	1,098	4.10
Advanced Placement Biology, Chemistry, or Physics (%)	578	2.23	1,098	1.68
GPA in Biology, Chemistry, and Physics	578	0.07	1,098	0.05
High School Status (%)				
Graduated	578	0.84	1,098	0.66
Dropped out	578	0.88	1,098	0.32
General Educational Development (GED)	578	0.09	1,098	0.59

Source: MPR analysis file "UBMSImpact6.sas."

Note: Standard errors account for project clustering and were estimated using Taylor series linearization methods.

Table D.4

Sample Sizes and Standard Errors for Reported Impact Estimates: Table B.4

	African American		White		Hispanic	
	Sample Size	Standard Error	Sample Size	Standard Error	Sample Size	Standard Error
Overall						
Total Credits	633	0.55	522	0.82	306	0.92
Grade Point Average (GPA)	633	0.04	522	0.03	306	0.05
Math Courses Taken						
Algebra (%)	633	1.19	522	0.00	306	2.46
Geometry (%)	633	2.82	522	2.07	306	5.01
Algebra II (%)	633	5.78	522	5.67	306	5.66
Trigonometry (%)	633	5.48	522	7.27	306	7.21
Analysis / Precalculus (%)	633	6.47	522	6.71	306	7.97
Calculus (%)	633	3.87	522	4.23	306	7.37
Advanced Placement Calculus (%)	633	2.46	522	1.78	306	4.31
GPA in Algebra or above	633	0.08	522	0.06	306	0.09
Science Courses Taken						
Biology (%)	633	1.69	522	1.33	306	1.19
Chemistry (%)	633	2.67	522	3.26	306	4.24
Physics (%)	633	5.79	522	6.16	306	7.06
Advanced Placement Biology, Chemistry, or Physics (%)	633	2.43	522	2.22	306	3.35
GPA in Biology, Chemistry, and Physics	633	0.06	522	0.06	306	0.12
High School Status (%)						
Graduated	633	0.00	522	1.09	306	1.46
Dropped out	633	0.00	522	0.00	306	1.65
General Educational Development (GED)	633	0.00	522	0.84	306	0.00

Source: MPR analysis file "UBMSImpact6.sas."

Note: Standard errors account for project clustering and were estimated using Taylor series linearization methods.

Table D.5

Sample Sizes and Standard Errors for Reported Impact Estimates: Table B.5

	Sample Size	Standard Error
Postsecondary Enrollment (%)		
Any postsecondary institution	1,438	0.99
Highest level of schooling attended		
Four-year college or university	1,438	2.28
Two-year college	1,438	1.99
Vocational institution	1,438	0.96
College Selectivity (%)		
Most selective four-year college or university		
More selective	1,438	3.44
Less selective	1,438	4.05
Postsecondary Credits Earned (mean)		
Two- and four-year colleges and universities	1,158	5.0
Four-year colleges and universities	1,158	5.7
Two-year colleges and universities	1,158	2.3
Postsecondary Completion (%)		
Any degree, certificate, or license	1,438	3.54
Highest degree, certificate, or license earned		
Bachelor's degree or higher	1,438	3.70
Associate's degree	1,438	1.70
Certificate or license	1,438	1.52

Source: MPR analysis file "UBMSImpact6.sas."
Note: Standard errors account for project clustering and were estimated using Taylor series linearization methods.

Table D.6

Sample Sizes and Standard Errors for Reported Impact Estimates: Table B.6

	Participated in Regular Upward		Did Not Participate in Regular	
	Sample Size	Standard Error	Sample Size	Standard Error
Postsecondary Enrollment (%)				
Any postsecondary institution	552	1.15	886	1.18
Highest level of schooling attended				
Four-year college or university	552	4.54	886	2.47
Two-year college	552	4.89	886	2.01
Vocational institution	552	0.00	886	1.30
College Selectivity (%)				
Most selective four-year college or university				
More selective	552	5.56	886	3.79
Less selective	552	5.88	886	4.49
Postsecondary Credits Earned (mean)				
Two- and four-year colleges and universities	432	7.40	726	5.38
Four-year colleges and universities	432	8.73	726	6.24
Two-year colleges and universities	432	4.71	726	2.28
Postsecondary Completion (%)				
Any degree, certificate, or license	552	5.88	886	3.86
Highest degree, certificate, or license earned				
Bachelor's degree or higher	552	5.19	886	4.14
Associate's degree	552	2.77	886	1.92
Certificate or license	552	2.08	886	1.79

Source: MPR analysis file "UBMSImpact6.sas."

Note: Standard errors account for project clustering and were estimated using Taylor series linearization methods.

Table D.7

Sample Sizes and Standard Errors for Reported Impact Estimates: Table B.7

	Male		Female	
	Sample Size	Standard Error	Sample Size	Standard Error
Postsecondary Enrollment (%)				
Any postsecondary institution	480	1.62	957	1.31
Highest level of schooling attended				
Four-year college or university	480	3.66	957	2.76
Two-year college	480	3.80	957	2.29
Vocational institution	480	1.11	957	1.32
College Selectivity (%)				
Most selective four-year college or university				
More selective	480	5.25	957	3.65
Less selective	480	5.76	957	4.48
Postsecondary Credits Earned (mean)				
Two- and four-year colleges and universities	377	7.80	780	4.85
Four-year colleges and universities	377	8.97	780	5.47
Two-year colleges and universities	377	4.73	780	2.43
Postsecondary Completion (%)				
Any degree, certificate, or license	480	5.17	957	4.02
Highest degree, certificate, or license earned				
Bachelor's degree or higher	480	4.70	957	3.97
Associate's degree	480	3.35	957	1.74
Certificate or license	480	2.43	957	1.74

Source: MPR analysis file "UBMSImpact6.sas."
Note: Standard errors account for project clustering and were estimated using Taylor series linearization methods.

Table D.8

Sample Sizes and Standard Errors for Reported Impact Estimates: Table B.8

	African American		White		Hispanic	
	Sample Size	Standard Error	Sample Size	Standard Error	Sample Size	Standard Error
Postsecondary Enrollment (%)						
Any postsecondary institution	523	1.46	468	1.99	261	3.08
Highest level of schooling attended						
Four-year college or university	523	3.28	468	4.52	261	3.87
Two-year college	523	3.37	468	3.98	261	3.60
Vocational institution	523	1.00	468	2.58	261	0.01
College Selectivity (%)						
Most selective four-year college or university						
More selective	523	5.41	468	5.92	261	7.61
Less selective	523	6.33	468	6.07	261	7.95
Postsecondary Credits Earned (mean)						
Two- and four-year colleges and universities	405	7.24	394	8.10	211	9.16
Four-year colleges and universities	405	8.08	394	9.81	211	9.57
Two-year colleges and universities	405	2.63	394	4.33	211	5.37
Postsecondary Completion (%)						
Any degree, certificate, or license	523	6.30	468	5.01	261	6.62
Highest degree, certificate, or license earned						
Bachelor's degree or higher	523	6.09	468	4.96	261	6.59
Associate's degree	523	3.29	468	3.46	261	4.31
Certificate or license	523	2.50	468	1.23	261	3.66

Source: MPR analysis file "UBMSImpact6.sas."
Note: Standard errors account for project clustering and were estimated using Taylor series linearization methods.

Table D.9

Sample Sizes and Standard Errors for Reported Impact Estimates: Table B.9

	Sample Size	Standard Error
Field of Study at Most Recent PS Institution		
All PS institutions		
Math and science fields	1,438	3.73
Social science fields	1,438	2.37
Other fields	1,438	3.33
Four-year colleges and universities		
Math and science fields	1,438	3.53
Social science fields	1,438	2.37
Other fields	1,438	3.23
Earned Degree or Certificate in Field		
All PS institutions		
Math and science fields	1,438	2.84
Social science fields	1,438	2.13
Other fields	1,438	2.69
Four-year colleges and universities		
Math and science fields	1,438	2.78
Social science fields	1,438	2.17
Other fields	1,438	2.56

Source: MPR analysis file "UBMSImpact6.sas."
Note: Standard errors account for project clustering and were estimated using Taylor series linearization methods.

Table D.10

Sample Sizes and Standard Errors for Reported Impact Estimates: Table B.10

	Participated in Regular Upward		Did Not Participate in Regular	
	Sample Size	Standard Error	Sample Size	Standard Error
Field of Study at Most Recent PS Institution				
All PS institutions				
Math and science fields	552	5.98	886	4.48
Social science fields	552	4.70	886	2.64
Other fields	552	6.10	886	4.01
Four-year colleges and universities				
Math and science fields	552	5.76	886	4.21
Social science fields	552	4.55	886	2.63
Other fields	552	5.72	886	3.74
Earned Degree or Certificate in Field				
All PS institutions				
Math and science fields	552	3.99	886	3.34
Social science fields	552	2.90	886	2.49
Other fields	552	4.59	886	3.15
Four-year colleges and universities				
Math and science fields	552	2.89	886	3.59
Social science fields	552	2.94	886	2.67
Other fields	552	3.75	886	2.79

Source: MPR analysis file "UBMSImpact6.sas."

Note: Standard errors account for project clustering and were estimated using Taylor series linearization methods.

Table D.11

Sample Sizes and Standard Errors for Reported Impact Estimates: Table B.11

	Male		Female	
	Sample Size	Standard Error	Sample Size	Standard Error
Field of Study at Most Recent PS Institution				
All PS institutions				
Math and science fields	480	6.16	957	4.14
Social science fields	480	4.21	957	2.57
Other fields	480	4.81	957	4.09
Four-year colleges and universities				
Math and science fields	480	5.94	957	4.11
Social science fields	480	3.72	957	2.60
Other fields	480	4.55	957	3.76
Earned Degree or Certificate in Field				
All PS institutions				
Math and science fields	480	3.87	957	3.50
Social science fields	480	2.42	957	2.49
Other fields	480	3.69	957	3.44
Four-year colleges and universities				
Math and science fields	480	3.66	957	3.86
Social science fields	480	2.18	957	2.66
Other fields	480	2.84	957	3.01

Source: MPR analysis file "UBMSImpact6.sas."
Note: Standard errors account for project clustering and were estimated using Taylor series linearization methods.

Table D.12

Sample Sizes and Standard Errors for Reported Impact Estimates: Table B.12

	African American		White		Hispanic	
	Sample Size	Standard Error	Sample Size	Standard Error	Sample Size	Standard Error
Field of Study at Most Recent PS Institution						
All PS institutions						
Math and science fields	523	5.84	468	6.00	261	7.31
Social science fields	523	3.42	468	3.23	261	4.95
Other fields	523	5.26	468	5.09	261	5.92
Four-year colleges and universities						
Math and science fields	523	6.25	468	4.94	261	11.09
Social science fields	523	3.63	468	3.18	261	3.70
Other fields	523	4.68	468	4.48	261	5.58
Earned Degree or Certificate in Field						
All PS institutions						
Math and science fields	523	4.64	468	5.17	261	7.69
Social science fields	523	3.11	468	3.08	261	3.26
Other fields	523	4.70	468	3.67	261	5.46
Four-year colleges and universities						
Math and science fields	523	5.85	468	4.82	261	6.85
Social science fields	523	3.06	468	3.08	261	3.65
Other fields	523	4.10	468	3.66	261	4.73

Source: MPR analysis file "UBMSImpact6.sas."

Note: Standard errors account for project clustering and were estimated using Taylor series linearization methods.

Table D.13

Sample Sizes and Standard Errors for Reported Impact Estimates: Table C.1

	Sample Size	Standard Error
Postsecondary Enrollment (%)		
Any postsecondary institution	1,438	1.75
Highest level of schooling attended		
Four-year college or university	1,438	2.54
Two-year college	1,438	1.97
Vocational institution	1,438	0.70
College Selectivity (%)		
Most selective four-year college or university		
More selective	1,438	3.34
Less selective	1,438	3.78
Postsecondary Credits Earned (mean)		
Two- and four-year colleges and universities	1,438	4.53
Four-year colleges and universities	1,438	4.86
Two-year colleges and universities	1,438	1.78
Postsecondary Completion (%)		
Any degree, certificate, or license	1,438	3.50
Highest degree, certificate, or license earned		
Bachelor's degree or higher	1,438	3.71
Associate's degree	1,438	1.61
Certificate or license	1,438	1.53

Source: MPR analysis file "UBMSImpact6.sas."
Note: Standard errors account for project clustering and were estimated using Taylor series linearization methods.

Table D.14

Sample Sizes and Standard Errors for Reported Impact Estimates: Table C.2

	Participated in Regular Upward		Did Not Participate in Regular	
	Sample Size	Standard Error	Sample Size	Standard Error
Postsecondary Enrollment (%)				
Any postsecondary institution	552	3.46	886	1.92
Highest level of schooling attended				
Four-year college or university	552	5.18	886	2.68
Two-year college	552	4.89	886	2.07
Vocational institution	552	0.00	886	0.92
College Selectivity (%)				
Most selective four-year college or university				
More selective	552	5.18	886	3.69
Less selective	552	5.87	886	4.19
Postsecondary Credits Earned (mean)				
Two- and four-year colleges and universities	552	6.67	886	4.89
Four-year colleges and universities	552	7.39	886	5.36
Two-year colleges and universities	552	3.36	886	1.90
Postsecondary Completion (%)				
Any degree, certificate, or license	552	5.98	886	3.82
Highest degree, certificate, or license earned				
Bachelor's degree or higher	552	4.97	886	4.11
Associate's degree	552	2.77	886	1.83
Certificate or license	552	2.02	886	1.90

Source: MPR analysis file "UBMSImpact6.sas."
Note: Standard errors account for project clustering and were estimated using Taylor series linearization methods.

Table D.15

Sample Sizes and Standard Errors for Reported Impact Estimates: Table C.3

	Male		Female	
	Sample Size	Standard Error	Sample Size	Standard Error
Postsecondary Enrollment (%)				
Any postsecondary institution	480	3.07	957	2.12
Highest level of schooling attended				
Four-year college or university	480	4.09	957	3.04
Two-year college	480	3.90	957	2.09
Vocational institution	480	0.81	957	0.87
College Selectivity (%)				
Most selective four-year college or university				
More selective	480	5.11	957	3.63
Less selective	480	5.59	957	4.47
Postsecondary Credits Earned (mean)				
Two- and four-year colleges and universities	480	6.71	957	5.12
Four-year colleges and universities	480	7.10	957	5.21
Two-year colleges and universities	480	2.95	957	2.26
Postsecondary Completion (%)				
Any degree, certificate, or license	480	4.92	957	4.04
Highest degree, certificate, or license earned				
Bachelor's degree or higher	480	4.57	957	4.03
Associate's degree	480	2.87	957	1.75
Certificate or license	480	2.21	957	1.98

Source: MPR analysis file "UBMSImpact6.sas."
Note: Standard errors account for project clustering and were estimated using Taylor series linearization methods.

Table D.16

Sample Sizes and Standard Errors for Reported Impact Estimates: Table C.4

	African American		White		Hispanic	
	Sample Size	Standard Error	Sample Size	Standard Error	Sample Size	Standard Error
Postsecondary Enrollment (%)						
Any postsecondary institution	523	2.64	468	3.43	261	4.57
Highest level of schooling attended						
Four-year college or university	523	3.79	468	4.96	261	5.10
Two-year college	523	2.98	468	4.74	261	4.41
Vocational institution	523	0.96	468	1.52	261	0.00
College Selectivity (%)						
Most selective four-year college or university						
More selective	523	4.93	468	5.85	261	7.88
Less selective	523	5.90	468	6.13	261	7.49
Postsecondary Credits Earned (mean)						
Two- and four-year colleges and universities	523	7.08	468	7.12	261	10.13
Four-year colleges and universities	523	7.25	468	8.83	261	9.96
Two-year colleges and universities	523	2.10	468	4.00	261	3.97
Postsecondary Completion (%)						
Any degree, certificate, or license	523	6.33	468	4.84	261	6.69
Highest degree, certificate, or license earned						
Bachelor's degree or higher	523	6.12	468	4.94	261	6.59
Associate's degree	523	3.18	468	3.47	261	4.23
Certificate or license	523	2.70	468	0.99	261	4.00

Source: MPR analysis file "UBMSImpact6.sas."
Note: Standard errors account for project clustering and were estimated using Taylor series linearization methods.

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